



Sustainability Handbook

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Benoît Le Roy is an environmental alchemist with forty years of water engineering experience and is the CEO and co-founder of the South African Water Chamber established to represent the private water infrastructure sector to collaborate with and assist government to implement the national water and sanitation master plans; he is also a founding director of Nexus Water Alchemy and Water Ledger South Africa, both incorporated South African companies at the leading edge of the nexus of water digitisation. This will not only be key in reindustrialising the water sector, but it will also provide a myriad of skilled jobs and the opportunity to again export water related products and expertise globally.

**CATHERINE WIJNBERG**

Catherine Wijnberg is the Director and Founder of Fetola, a leading provider of scalable, world-class entrepreneurial support programmes for African entrepreneurs which helps people build businesses that last through scalable solutions that deliver social, environmental and economic impact. Fetola means “change” in Sesotho - and they aim to empower people through supporting the growth and development of sustainable, empowered and thriving small and medium enterprises (SMEs) at scale. She is a thought leader on small business development, sustainability and circularity, with a particular passion for effecting scalable impact at the ecosystem level for leadership development.

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Over his 40-year career in engineering, Chris Campbell has worked in various capacities in a number of successful consulting engineering companies, spent several years at Transnet Freight Rail and has held executive positions at Aveng Infraset, both locally and internationally. His institutional involvement includes past Gauteng Branch Chair (SABTACO); past Vice President of the South African Institution of Civil Engineering (SAICE); past President of the Engineering Council of South Africa (ECSA); past Vice President of The World Federation of Engineering Organisations (WFEO). Currently he is a Board Member of Business Unity South Africa (BUSA). Chris, a registered Professional Engineer, holds a National Higher Diploma (T4) in Civil Engineering; a BSc. Civil Engineering degree (Summa Cum Laude).

**MATHETHA MOKONYAMA**

Dr. Mathetha Mokonyama leads the transport systems and operations impact area at the CSIR. Apart from his research interest in sustainable transport provision, he is passionate about the development of young professionals in the built environment.

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Henk is currently the Principal Technical Manager at Aquaculture within the Department of Animal Science from the University of Stellenbosch. He holds a Master's degree in Animal Production (MPhil) Aquaculture. He has also followed several International Aquaculture Training courses over the years in countries like the USA, China, Switzerland, Ghana, Kenya and the Philippines. Henk is the current Vice-Chairman of the Aquaculture Association of Southern Africa. He is also acting as an EXCO Member on various local Aquaculture Industry Associations for instance the Western Cape Trout Association (Chairman) and the Tilapia Aquaculture Association of SA. He was a founding member of the Aquaponics Association of South Africa and served on the EXCO for 3 years as the Secretariat. Henk's experience in Aquaponics goes back to 2012 when he helped to design and construct the first Aquaponics research system at Stellenbosch University. Since then he was involved in Aquaponics for the past 9 years. He has completed Aquaponics Training Workshops presented by James Rakocy (USA), Murray Hallam (Australia) and Leslie Ter Morshuizen (SA). Henk was an extraordinary member of the EU Aquaponics HUB and one of the Keynote Speakers at their Aquaponics Conference in Slovenia during 2016.

**DAVID NICHOLLS**

Mr David Nicholls is highly respected in the nuclear industry and regarded as a non-compromising leader who gets things done. He holds a BSc (Hons) in Mechanical Engineering (2-1) from the Royal Naval Engineering College, Manadon. He was responsible for the nuclear new build programme and overseeing the Koeberg power station until his retirement in December 2018. While at the utility he revitalised the Pebble Bed Modular Reactor (PBMR), an area in which South Africa was a world leader. He had worked his way up through the ranks at Eskom, working in its nuclear engineering department in the early 1980s before being appointed as Technical Support Manager at Koeberg in the early 1990s. He headed up the PBMR project. He was later appointed Chief Nuclear Officer at Eskom, and has experience managing Koeberg, which is the lowest cost provider of electricity to the grid. With 33 years of experience at Eskom, Dave Nicholls is no stranger to the Nuclear industry. Previously Chief Nuclear Officer at Eskom, accountable for all Eskom's nuclear activities, including the operation of the Koeberg Nuclear Power Station. He was also the General Manager for Nuclear Engineering, accountable for Nuclear Engineering at Koeberg and new build nuclear programme.

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Abram Marema holds an MCom in Economics (Cum Laude) from the University of South Africa (UNISA). He is a researcher in the Energy Industry Research Group at CSIR. He has been involved in a number of energy-related projects in support of the Just Energy Transition. His expertise includes energy economics and modelling, economic and socio-economic impact assessment, and the value chain analysis of renewable technologies.

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Donah Simiyu is a Researcher/Engineer at the Energy Industry in CSIR. She holds a Master's degree in Electrical Engineering (Energy Systems) from the University of Pretoria and Bachelor's degree in Electrical Engineering (Power Systems) from the University in Nairobi in Kenya. Donah has worked at Onga energy consulting and Lafarge where she gained valuable experience in energy research, energy optimization and maintenance. She is passionate about energy and climate change and is working towards her Doctorate degree in Electrical Engineering focusing on energy and climate change at the University of Pretoria. At the CSIR, Donah is a technical and engineering expert for research work related to the Just Energy Transition which promotes inclusion of the just aspect in the ongoing energy transition. She also provides technical support for SMME's in the energy space. Chris, a registered Professional Engineer, holds a National Higher Diploma (T4) in Civil Engineering; a BSc. Civil Engineering degree (Summa Cum Laude).

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Wandile Sihlobo, an agricultural economist by training, is Chief Economist of the Agricultural Business Chamber of South Africa (Agbiz). Sihlobo was appointed as a member of President Cyril Ramaphosa's Presidential Economic Advisory Council in 2019 after serving on the Presidential Expert Advisory Panel on Land Reform and Agriculture between 2018 and 2019. Sihlobo is also a member of the Council of Statistics of South Africa (Stats SA). He is a Commissioner at the International Trade Commission of South Africa (ITAC). Sihlobo is a columnist for Business Day and Farmers Weekly magazine. He is a member of the Agricultural Economics Association of South Africa (AEASA). Sihlobo is an author of "Finding Common Ground: Land, Equity and Agriculture" published by Pan Macmillan in March 2020. He is also a contributor to the book "Recession, Recovery and Reform" published by Jacana in August 2020. Sihlobo holds a Master of Science degree in Agricultural Economics from Stellenbosch University.

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Aradhna Pandarum is currently the Acting Research Group Leader for Energy Industry team in the Energy Centre of the Council for Scientific and Industrial Research (CSIR) who holds a Bachelor's degree in Electronic Engineering from Howard College UKZN and a Master's Degree in Electrical Engineering (Renewable Energy) from University of Witwatersrand. She serves as a technical board member of Cigre South Africa, representing the country in the international C6 study committee on active distribution systems and distributed energy resources. She is also registered as a Professional Engineer with the Engineering Council of South Africa (ECSA). She is passionate about research in the renewable energy space. Whilst working at Eskom, she has gained immense experience in research, testing, and development, especially on renewable energy, that was predominantly centred on embedded generation and its' technical, economic, operational, and environmental impact. At the CSIR, Aradhna is the programme and group leader for research work related to the Just Energy Transition. The focal point of this work is to promote social justice and create unique opportunities for the energy industry hence touching lives through innovation with the aim targeted at combating poverty, unemployment and inequality in South Africa.

**DIONNE KERR**

Founder and Chief Executive Officer of Siyakha Consulting, Dionne has actively advised both public and private sector clients in Transformation, Development and Strategy since leaving the banking industry in 1998. Working in BEE and Transformation since 1999, she has spoken at a multitude of conferences internationally on issues relating to South Africa. A regular contributor and thought leader on key elements of people, sustainability and aligning strategies to be locally relevant. With a strong portfolio of local and multinational clients, has served on several Executive committees and is an activist on issues of change and development.

**LLEWELLYN VAN WYK**

Llewellyn van Wyk is the principal researcher at UrbanLab, a research-based consultancy focusing on resilient and sustainable urban development. He retired from the Council for Scientific and Industrial Research's Smart Places Unit in 2019 as a Principal Researcher. He lectures online at the University of Johannesburg in the Department of Mechanical Engineering Sciences. He also tutors post-graduate master and doctoral students. He holds a Bachelor of Architecture and a Master's in Science (cum laude). Llewellyn is a researcher, guest lecturer and designer with extensive international experience. He is a leading scholar of 21st century green building and green infrastructure design discourses and innovative building technology.

**DAVID LIPSCHITZ**

David Lipschitz is a scientist and energy expert with a Bachelor of Science Honours Degree and an MBA. He started a Software Development business in 1994, an Energy business in 2008, and started attending and speaking at energy conferences in 2009. David motivates people to change how they think about their environment and shows people that it is possible to live a sustainable lifestyle with minimal impact on the earth. He appears in the press regularly. David has received several energy and environmental awards for his services to the environment. David's sixth book, The Last Blackout, was published in 2022.

**TSHWANELO RAKAIBE**

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**MR HITEN PARMAR
DIRECTOR: UYILO EMOBILITY PROGRAMME (SOUTH AFRICA)**

Hiten stands as a lead executive, thought leader and industry expert extending over 18 years in profession. As Director of South Africa's national electric mobility programme, he delivers to the mandate of enabling the uptake of electric mobility across both the public and private sectors. Hiten also serves as liaison for multiple sector related forums within South Africa, as well as internationally on advancing the electric mobility ecosystem.

Peer Review

Alive2green has introduced and is committed to peer reviewing a minimum number of published chapters in all Sustainability Series handbooks. The concept of peer review is based on the objective of the publisher to provide professional, academic content. This process helps to maintain standards, improve performance, and provide credibility.

Alive2Green Peer Review Process

The review process is blind, and multiple reviews are generally sought. Authors are provided with a redacted copy of a review form (that is with the identity of the reviewer removed). Reviewers are provided anonymised submissions and complete a review report which is returned to the editor. Reviews are assigned to individuals not affiliated with the authors' organisation.

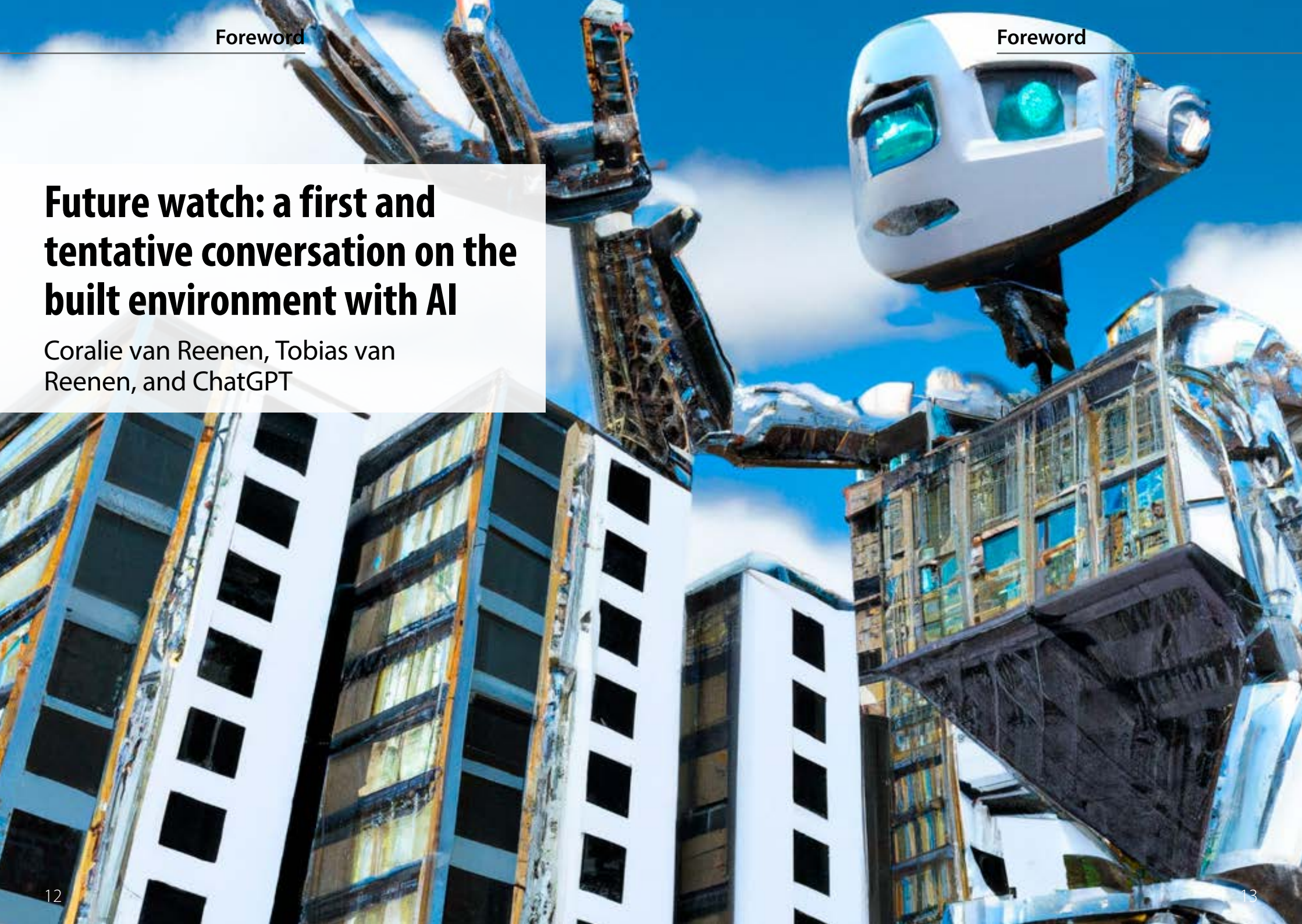
Review has both a quality assurance role and a developmental role, therefore constructive feedback and justification for outcomes is encouraged. For a chapter or article to be published in the handbook it should be clearly written, of interest to readers and be methodologically and technically sound. By submitting authors attest that they have referenced source material and have not violated copyright. For a chapter or article to be considered as a peer-reviewed item, it should also make a new contribution to knowledge. Authors and reviewers may be identified in the handbook front matter with a photo and short biography. Reviewers are required to excuse themselves from reviewing or participating in editorial decisions in any instance where conflicts of interest (including financial interests and relationships) arise or are likely to arise in the foreseeable future. Review reports are classified by the editor and stored in compliance with POPIA to protect the integrity of the review and publishing processes.





Future watch: a first and tentative conversation on the built environment with AI

Coralie van Reenen, Tobias van Reenen, and ChatGPT



As we continue to urbanize and develop our built environment, it is crucial that we prioritize sustainability in the design and construction of our buildings and infrastructure. The United Nations' Sustainable Development Goals (SDGs) have brought global attention to the need for sustainable development and the role that technology can play in achieving it.

This handbook is designed to provide a comprehensive overview of the key principles and strategies for building a more sustainable future. It covers a wide range of topics, from renewable energy and energy efficiency to sustainable materials and green infrastructure. With the help of cutting-edge technology, we can work towards creating a built environment that is environmentally, socially, and economically sustainable for all.

Sustainable development is about meeting the needs of the present without compromising the ability of future generations to meet their own needs. This means ensuring that our buildings and infrastructure are designed and constructed in a way that minimizes their impact on the environment and natural resources.

It also means creating communities that are livable and equitable, with access to clean water, healthy food, and transportation options.

One key aspect of sustainability in the built environment is the use of renewable energy sources. Solar, wind, and geothermal energy can provide clean, reliable, and affordable power for our buildings and infrastructure.

Energy efficiency is another important strategy for reducing our environmental impact and lowering energy costs. By using energy-efficient technologies and design strategies, we can reduce the amount of energy needed to power our buildings and infrastructure, which in turn reduces greenhouse gas emissions and other environmental impacts.

Sustainable materials are another important component of sustainable development. By using materials that are recycled, locally sourced, and produced with minimal environmental impact, we can reduce our reliance on finite natural resources and minimize waste. Green infrastructure, such as green roofs, rain gardens, and permeable pavement, can help manage stormwater runoff and improve air and water quality in our communities.

Technology plays a crucial role in enabling us to achieve sustainability in the built environment. From energy-efficient lighting and heating systems to smart building technologies that optimize energy use, there are many ways that technology can help us build a more sustainable future. By leveraging the latest innovations in sustainable design and construction, we can work towards creating buildings and infrastructure that are resilient, adaptable, and sustainable.

In conclusion, sustainability in the built environment is essential for ensuring a healthy and thriving future for all. This handbook provides a valuable resource for anyone looking to learn more about the key principles and strategies for building a sustainable future. By combining the latest technological innovations with a commitment to sustainability, we can work towards creating a built environment that is environmentally, socially, and economically sustainable for all.

The above paragraphs were composed by artificial intelligence (AI), using an open AI chat bot, ChatGPT.

From literature to design and construction, technology is becoming more and more adept and accessible to aid and augment our work in accomplishing our goals. We asked ChatGPT how AI can help us establish a more sustainable built environment, and the response was as follows:

There are many ways that artificial intelligence (AI) can help us establish a more sustainable built environment. For example, AI can be used to optimize the design and operation of buildings and infrastructure to reduce their energy and resource use.

AI-powered systems can monitor and control heating, lighting, and other building systems to minimize energy waste and improve efficiency. AI can also be used to analyze data from sensors and other sources to identify patterns and trends that can help inform decisions about the design and operation of buildings and infrastructure.

In addition, AI can help us reduce the environmental impact of the built environment by enabling us to better manage and recycle waste and other resources.

For example, AI can be used to sort and process waste materials, such as plastic, paper, and metal, to maximize their value and minimize their environmental impact. AI can also be used to identify and prioritize sustainable

materials and building practices, helping us to reduce our reliance on finite natural resources and minimize waste.

Furthermore, AI can help us improve the livability and resilience of the built environment by enabling us to better manage and adapt to changing conditions.

For example, AI can be used to monitor and predict weather patterns, enabling us to respond more effectively to extreme events, such as storms and floods. AI can also be used to identify and prioritize green infrastructure and other sustainable design strategies that can help improve air and water quality, reduce urban heat islands, and improve overall quality of life in our communities.

Overall, AI has the potential to play a transformative role in establishing a more sustainable built environment.

By leveraging the power of AI and other emerging technologies, we can work towards creating buildings and infrastructure that are efficient, resilient, and sustainable for all.

There are, of course, limitations to AI. We asked ChatGPT How much progress has South Africa made towards meeting its SDG goals?

I'm sorry, but I am not able to browse the internet to look up information about South Africa's progress towards meeting its SDG goals. I am a large language model trained by OpenAI, and my knowledge is based solely on the text that I have been trained on. My training data has a fixed cutoff point, so I do not have any information about events or developments that have occurred since then.

According to South Africa's sustainable development report, which is available at <https://dashboards.sdgindex.org/profiles/south-africa>, the country's SDG index rank is 108/163, it's SDG index score is 63.7, and it's spillover score is 91.0. While this information is easily found through common search engines, the chatbot is not able to draw on this data (yet).

Some may find it comforting that human intelligence has not been displaced by AI. There is a common concern that as AI technology continues to advance, it will become capable of performing many of the tasks currently done by humans, potentially leading to widespread job displacement. This is a complex issue that has many different factors and

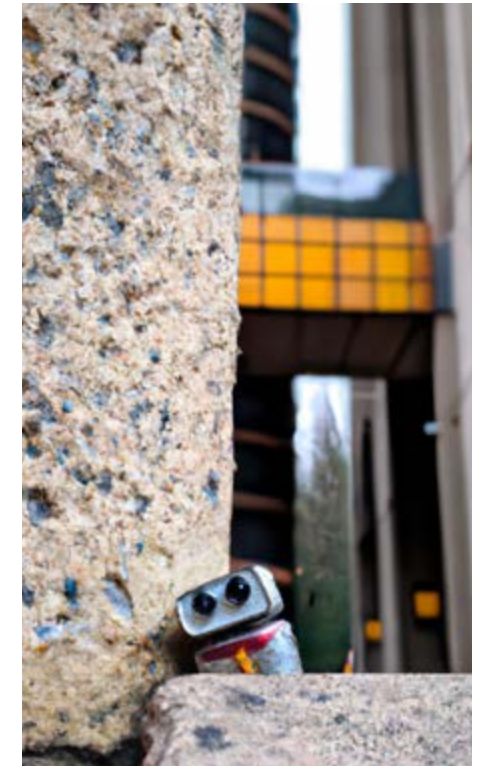
opinions, but it is definitely something that people are thinking about and discussing.

Some people argue that AI could create new job opportunities, while others are more skeptical and believe that it could have negative effects on the job market. It's important to approach this issue with care and consideration, and to take steps to ensure that any negative impacts are mitigated as much as possible.

This was a first and tentative conversation on the built environment with AI.

We hope to explore the role of AI in the future of the built environment further in the upcoming editions of the Sustainability Handbook. Until then, we trust that the contents of this edition will provide useful industry guidance and insight towards a more sustainable built environment.

To be continued...



Is sustainable leadership and a renewed focus the missing links to success?



Editor
Peta de Jager

The South African Institution of Civil Engineering (SAICE) recently published its latest infrastructure report card. Unsurprisingly, the findings reflected that in many instances our infrastructure assets are in poor and worsening shape.

At the launch of the report card, SAICE leadership were at pains to point out that despite this, there are pockets

of excellence. We need to identify good examples and the best practices and leadership approaches that ensure success. This edition of the Sustainability Handbook features a number of thought pieces from leaders in various sectors. It also features disruptive and experimental work. No doubt, simply continuing as we do, and expecting a different outcome is flawed. In this edition, Campbell provides thought leadership asking the question:

“Should the National Treasury be the custodians of Public Procurement?”

Self-proclaimed outlier and disruptor Lipshitz discusses the troubling, but fake, social media claiming that, as Eskom is not buying diesel for its peaking power stations, South Africa will be beset with a nationwide lasting blackout on 9th December 2022. Given South Africa's ongoing experiences with loadshedding, amplified by messages that many parts of the world face energy insecurity, such a message seemed both plausible and alarming. Implications ranging from knock on effects of water, food security and so on are unpacked, reminding us of the fragility and interconnected nature of our systems.

The South African Wind Energy Association points out that whilst the problem is simple, developing solutions is complex, and requiring appropriate planning expertise, which, it argues, can be promoted through the concept “energy liberalisation”. In another article, the question of whether nuclear energy is a potential option in South Africa's just energy transition is explored with reference to clean and safe sources of energy.

Pandarum, discusses how a proliferation of novel technologies has potential to include SMEs in a just transition through knowledge, empowerment, resourcing and capability. She then reviews precedent from literature on repurposing coal-fired power

station and coal mines, considering environmental, social, technical and economic pathways.

Whilst loadshedding has been dominating popular discussion, water shedding has become a stark reality over the past decade. In its opinion on water status in South Africa, the South African Water Chamber CEO, Le Roy, discusses how this phenomenon is increasingly affecting metros.

Moreover, Le Roy notes, much of this could be avoided. Lepelle Northern Water (LNW), which provides water to an estimated 3 million people in Limpopo, has recently appointed a new CEO who has established a vision for LNW “to claim place among SA's top three”.

CEO Wijnberg expresses the view that in abrogating responsibility to achieving 1.5 °C goal, COP 27 leaders have handed the baton to wider global community of citizens business and impact investors, suggesting initiatives to achieve a vision of zero waste.

Sihlobo suggests that there is consensus among agricultural role players that sustainable growth in South Africa's agricultural sector cannot only be achieved through the expansion of production an expansion of export markets should be a key support pillar for growth. Expansion implies land use change. Ecologically, soils provide a range of ecosystem services such as nutrient cycling carbon sequestration water filtration and storage and are therefore considered an integral part of many natural systems. Soil organic matter is often equated with soil quality. However, Swanepoel points out, soil cultivation negatively influences carbon content of soil, particularly when changing land use from natural vegetation to cultivated land, contributing to greenhouse gas emissions. Considering these issues conservation of carbon in soil and best management practices are discussed.

Stander shifts scale to the South African Development Community (SADC), observing that a significant challenge is that member states also participate in other regional economic cooperation schemes which may compete with or undermine SADC's aims. After a brief introduction to aquaponics and its history, he raises the need for agricultural training, and discusses potential for a hybrid aquaponics training program which is interdisciplinary in nature.

Parmar posits that, with air pollution one of the biggest threats to human health, accelerated electric vehicle deployments across world markets may help combat increased direct and indirect respiratory-linked deaths caused by combustion of petrol and diesel across the transport sector. Rathogwa and Mokonyama use systems dynamics modeling to facilitate sustainable decision making and improved planning and implementation of integrated public transport networks as effective spatial transformation instruments in South African cities.

Apart from focusing on established leadership, South Africa needs to place renewed focus on providing opportunities for the youth and including them in sustainable futures. The youth employment service (YES) is introduced as an investment in sustainable careers for our country and economy.

With an expanding distribution and growing readership, three editions of the Sustainability Handbook “in the bag” for 2022, and a further three planned for 2023, I have recruited the support of a young assistant editor, Mapula Matlakala. Well-known in South Africa's green building community, she will bring fresh ideas and improved capacity to our team and I look forward to working together.

Matlakala has already set the themes for the upcoming edition which is set out in the call for papers on page 18.



Assistant editor
Mapula Matlakala

CALL FOR PAPERS

Dear Prospective Author,

Thank you for considering contributing a chapter or article to the Sustainability Handbook.

The handbook is collected work, assembled from many scholars in the field of sustainability of the built environment and industry across Africa, featuring both refereed and non-refereed (popular interest) chapters and articles. The purpose of the handbook is to disseminate original research and new developments within the field and to advance scholarship. The most recent edition of the Sustainability Handbook series can be viewed by clicking on the link.

Refereed chapters are thematically arranged for water, waste, green building, energy or sustainable transport.

The featured themes for Volume 5 are circular economy, and sustainability for just regeneration, although any sustainability topics relevant to the built environment and industry will be considered. For a chapter or article to be published in the handbook it should be clearly written, be of interest to readers and be methodologically and technically sound. It must reference source material and not violate copyright. For a chapter or article to be considered as a refereed item, it should also make a new contribution to knowledge.

STEP 1: submit a title and 500 word abstract describing what your paper intends to cover by the abstract deadline. This will be received by the editor who will check that it is suitable. Refereed chapters are peer reviewed by subject matter experts identified by the publisher/ editor. If the item seems suitable, authors will be invited to prepare a full chapter manuscript.

STEP 2: Authors submit a 5000 word full chapter to the editor by the deadline indicated and this will be redacted to remove identifying features and sent to between one and three experts in the field. Authors will be provided feedback from their anonymous reviewers (via the editor) a few days after the review deadline and will be provided a limited time to respond to reviewers' feedback. Authors may be required to arrange independent professional language or grammar edits, at their own cost.

STEP 3: The editor reviews amended chapters received and if they are of good quality will release them to the publishers for layout and digital publishing. Photos and brief biographies of authors are included in the front-matter of the handbook. The publisher and editor reserve the right to make minor adjustment and will provide a final proof before publishing.

Whilst every effort is made to comply with Department of Higher Education and Training, Research Outputs Policy of 2015, this is not guaranteed, and prospective authors are advised to seek confirmation from their institutional offices in this regard.

Don't hesitate to contact me for further information.

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6th edition March 31, 2023	01 November 2022	Send call to prospective authors for the 6 th edition
	15 December 2022	Abstract deadline
	03 February 2023	Paper deadline
	10 March 2023	Authors final submission
	31 March 2023	Layout + Publishing
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	14 April 2023	Abstract deadline
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	07 July 2023	Authors final submission
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	06 October 2023	Paper deadline
	10 November 2023	Authors final submission
	01 December 2023	Layout + Publishing

Green finance linkages for industry

Transitioning to a green economy is no longer just a moral conversation but a business imperative. The impact of climate change is evident, with extreme weather conditions and natural disasters becoming commonplace across the globe. This impacts livelihoods, the security of resources, integrity of ecosystems and economies.

Sustainable business practices are now key drivers of economies, such that grant funders, banks and some government structures finance and even incentivise green projects.

Access to finance for green projects has, however, proven a challenge for most organisations and Small, Medium and Micro Enterprises (SMMEs). The National Cleaner Production Centre South Africa (NCPC-SA), through sustainable finance workshops, online guides and tools, assists industry in establishing financial linkages with funders.

This year alone, the NCPC-SA hosted three workshops on sustainable finance where attendees had an opportunity to hear from and share their access to finance challenges with experts. "It took our business seven years to access the right kind of funding, but attending the NCPC-SA workshops helped us expedite the process," said Johanathan Govender of OTRP Group at a recent workshop.

Whilst the NCPC-SA itself cannot provide financing for companies, the industry support programme can provide free assessments where appropriate and assist

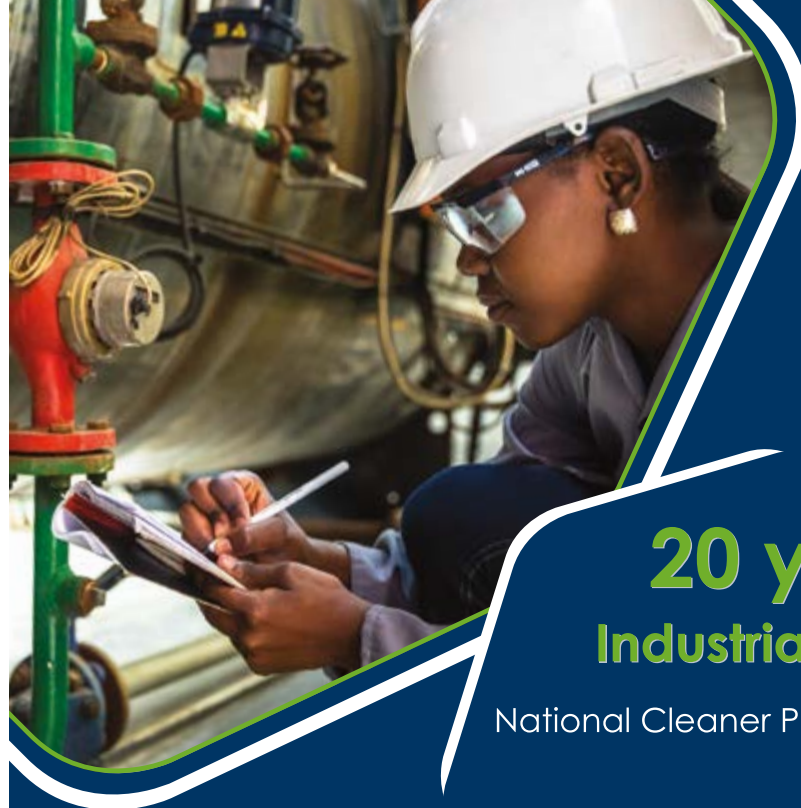
in developing necessary technical reports to support applications.

NCPC-SA Project Manager Lindelani Mkhize said, "Our assessment work helps industry identify which interventions can be implemented with minimal or no cost and which require a capital injection." "So, the organisation needs to understand their project well before approaching a funder," he adds.

The funding mechanisms for green projects are in their nature diverse and funders have different requirements. For instance, commercial banks may fund one hundred percent of the project in the form of a loan depending on the applicant's financial health and other factors, while agencies like the Development Bank of Southern Africa (DBSA) will support a portion of the project as a grant fund. In the latter case, the applicant will have to raise the other bit through other means. Their project would also need to respond to what the grant funder deems a match to their objectives (i.e., responds to infrastructure development).

South Africa's other common green project funding option is through the Department of Trade, Industry and Competition (the dtic) incentives. There are, however, prerequisites to accessing these incentives. The incentive scheme is on cost-sharing bases and has thresholds depending on the type of incentive. While exploring these options may not be exhaustive, they could help organisations kick off their transition journeys.

For more information, email ncpc@csir.co.za or visit www.ncpc.co.za.



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INDUSTRIAL EFFICIENCY IN SOUTH AFRICA

Geopolitics and Africa's just transition

Dr Mao Amis & Olga Mapanje

Executive Summary

Africa's transition to clean energy is prone to global geopolitics. The current global energy crisis as a result of the invasion of Ukraine by Russia has led to a general increase in prices of food and other related commodities around the world. This is happening at a time when many countries are gradually recovering from the impacts of the Covid-19 pandemic. Looking at the discourse of the just transition across the world, Africa's position and understanding need to be put within the contextual realities of the continent. Millions of people in Africa are hungry, energy impoverished, and depend on unclean energy. Additionally, over 80% of the population is in the informal sector, and they operate from the bottom of the pyramid. Given this, the discussion about the just transition in Africa needs to be centred on the socio-economics of the continent. Africa is vulnerable to climate change because it has a very low socio-economic base. It is the least climate-resilient region and lacks the capacity and climate finance for adaptation and/ or mitigation.

A just transition in Africa should ensure more access to resources. It should be about equity, putting food on the table, and more money in more pockets.



Additionally, the discussions should shift to how Africa can leverage its abundance to cushion the livelihoods against shocks; because emergencies and calamities will continue. There is a need to climate-proof Africa so that the continent can be socio-economically viable and lift its people from the bottom of the pyramid.

Key Recommendations for policymakers:

- Need for clearly defined policy frameworks that foster closer ties with the private sector
- It is important for African governments to know that the transition is a journey. It requires them to understand the socio-economics of their nations and to create systems that would actually make a difference in people's lives. This transition should be driven using an evidence-based and inclusive manner process.
- Prioritize interventions that empower the youth and women
- Young people and women should be at the forefront of advancing the just transition in Africa. Therefore, there is a need to put in place interventions that prioritize them, in both the rural and urban sectors. Governments should put in place policy incentives, especially fiscal incentives like tax breaks to promote the growth of female/ youth-led businesses.
- Prioritize the mobilization of domestic investment
- African countries should mobilize domestic investments required for the just transition, instead of being always at the mercy of geopolitical ructions in the world. Investors must see the various opportunities of renewables and the new industrial opportunities that are presented by critical minerals and green hydrogen in the midst of this crisis.
- Scale-up solutions that work, leaving no one behind
- Renewable energy enterprises have been impacting the lives of vulnerable communities and the best enterprises are those that deliver energy access to villages. These enterprises however are not as attractive to investors. Therefore, scaling up requires us to appreciate the importance of localizing these interventions, appreciating the value of failing and learning from failure, and lastly being experimental.
- Need for capacity building in order to have adequate resources to deliver the outcomes
- To promote innovation and investment toward net-zero transition, African governments need to

put extra effort into building strong and efficient institutions and developing their human resources.

Background

Why geopolitics will play a key role in determining just transition

The current economic models in most African countries are dysfunctional, hence there is a high level of unemployment, inequality, environmental degradation, and many other socio-economic challenges. The trajectory under which the world economic model is undertaken is highly dependent on growth, and it is not working. This has resulted in a lot of people being left behind in poverty. Recognizing that we face systematic challenges in relation to global change, we need to transition into a world that is much more sustainable and more importantly, a world that is more inclusive and does not leave anyone behind. The concept of just transition is how we transition while making sure that even the most vulnerable people and communities are not left behind. However, the concept of just transition cannot be disconnected from politics and the broader issue around the geographical dynamics of how governance systems work.

There are 2 main dimensions to the issue around just transition:

1. Distribution taking into consideration fairness.
2. Ensuring that everyone is brought along in terms of the processes required to transition

Geopolitics comes in more prominently because countries and communities do not live in isolation. Independent government systems do interact. These politics have a direct implication on how these systems are actually getting implemented and how the strategies are implemented on the ground.

From African countries, we have seen the dynamics around poor trade between countries, and issues around lack of effective corporative interaction around transboundary management of resources.

Geopolitics is about how governance systems related to geographical location intersect, and what the implications are on how some of these environmental policies and strategies get implemented on the ground.

Taking a look at the geopolitics vis-à-vis climate change; before the energy crisis, the African citizenry was already vulnerable to the changing climate; due to the low socioeconomic base.

Unless the young people of Africa who are 60 percent of the population are at the center of the just transition, it will never be successful. In Uganda for instance, the just energy transition must be inclusive



if it is to be successful. The private sector in Uganda has been trying to influence the government of Uganda to implement a green agenda. For example, they insisted that in the distribution of the Covid-19 recovery fund, priority should be given to SMEs that focused on green enterprises. However, the challenge is that most SMEs in the country are not bankable.

This is part of the goal of ACODE, to conscientise the key stakeholders regarding the importance of the green economy. The solutions to Africa's challenges should come from within, by building resilience and adaptation to climate change. Diversification to clean energy is the way to go in the future.

Why discuss Geopolitics and Africa's Transition now?

Africa's transition to clean energy is being derailed by the oil and gas crisis, which has forced a number of nations around the world to go back to the exploitation of coal deposits. The transition is prone to global geopolitics. As the pandemic slowly began to ebb away last year and countries began opening up, leading economists predicted that this would

lead to an energy crisis and an increase in the price of goods and services causing inflationary pressure in the world.

It was anticipated that world economic growth would be sluggish. Multilateral institutions such as the IMF advised countries to adopt proactive policies to spur economic growth while also sticking to the commitments to an energy transition which they agreed to at COP26.

However, the war in Ukraine has upended all that. Sanctions on Russia, a major producer of oil, gas, and other important commodities such as wheat, fertilizer, and minerals have led to a sharp increase in commodity prices around the world. The increase in energy prices is forcing the rich world whose economies are highly dependent on fossil fuels to invest resources that would have otherwise gone into aiding the energy transition, to the extraction and exploration of oil and gas to compensate for scarcity in the global chain.

Other countries like Germany¹ and the UK have gone further ahead to reopen coal plants that had been mothballed as part of their shift to clean energy.

In addition, it was reported in the press that Italy² had signed agreements to import gas from Angola and Nigeria to compensate for the energy shortfall. All this implies that the nations' plan to cut emissions and achieve the targets agreed to at COP26 increasingly looks set to fail.

This spells doom for Africa, the continent most vulnerable to the effects of climate change because, unlike the rich world, it is a victim of climate change.

Beset by other challenges such as environmental degradation, weak state institutions, and poverty, it makes it difficult to dedicate enough resources to deal with climate change.

An example is the drought currently ravaging the horn of Africa and parts of East Africa. Many countries in this part of the continent have been experiencing conflicts internally and externally for a long time.

State institutions in these countries have gradually weakened and are unable to lift most of the people out of poverty.

The drought is exacerbating these conflicts and prolonging them. Scientists predict droughts in this region will become more frequent and will have devastating impacts on people and livestock, while

also aggravating conflicts between communities and states.

African countries & response to the global crisis

Africa is the only region in the world where energy poverty is expected to increase over the coming decades. This is detrimental to poverty reduction, job creation, health, education, and other SDG-related areas in the continent. Most African countries are net-energy importers; with some exporting crude oil and importing refined petroleum products. The hike in the commodity prices of energy, food, and other related products as a result of the invasion of Ukraine by Russia is expected to exacerbate inflation in Africa, and this is happening at a time when the global economy is gradually recovering from the negative effects of the Covid-19 pandemic.

At a global energy forum that was held in Sydney, the Executive Director of the International Energy Agency (IEA) and one of the world's foremost energy economists Fatih Birol warned³ that:

"The world has never witnessed such a major energy crisis in terms of its depth and its complexity."



The continent has just recovered from the COVID-19 pandemic, and it is now hit with hikes in oil and food prices. Economists have warned that as a result of this crisis, commodity prices could further increase throughout the year, with the average inflation in Africa projected to accelerate to 13.5% in 2022, from 13% in 2021⁴. Additionally, according to the African Development Bank, this year alone, approximately 1.8 million Africans should be pushed further back into poverty. This has called for varied response measures and African leaders have responded differently.

Of significant importance is the Dakar Call to Action⁵, where African leaders from Egypt, Ethiopia, Kenya, Madagascar, Zimbabwe, Malawi, and many other African countries convened in Dakar, Senegal, on the 7th of July 2022 to come up with an action plan that will help them overcome crises and achieve economic transformation in the continent. This will be done with support from the World Bank Group, through its International Development Association (IDA) program. African leaders who convened at this Summit noted with concern that Africa is experiencing reversals of its development gains and this is triggered by global crises such as climate change, the COVID-19 pandemic, conflicts in the region, and the ongoing war in Ukraine.

Speaking at the Summit the President of the Republic of Senegal, and the current chairperson of the African Union, President Macky Sall said,

“We are convening this Summit in a context of deep crisis, marked by the double impact of the COVID-19 pandemic and the war in Ukraine. While we have exponentially increased our spending to respond to the health crisis and foster the economic and social resilience of our people, our fiscal space has shrunk dramatically, and debt vulnerabilities were exacerbated.”

Present at the Dakar Summit also were leaders from the World Bank Group and the United Nations. The World Bank Group assured the African leaders that they will continue to support Africa’s development and achievement of SDGs on the continent. Axel van Trotsenburg, World Bank Managing Director for Operations said,

“We are therefore investing about two-thirds of IDA20 financing in Africa, to help the continent make a huge leap forward in creating jobs, and

improving access to services such as education, health care, electricity, and others.”

- To this end, the African leaders endorsed a call to action which has the following undertakings:
- Accelerate economic transformation to better respond to future shocks
- Invest in people
- Speed up the energy transition
- Accelerate digitalization
- Strengthen response mechanisms to address food security
- Step-up implementation of the African Continental Free Trade Area

Historically Africa has suffered from a variety of global challenges- droughts, cyclones, etc. Today Africa is a continent that is already suffering from the climate change crisis. If we look at the discourse of the just transition across the world, Africa’s position and understanding need to be put within the contextual realities of the continent. Some of these realities are:

- 257 million people in Africa are going to bed hungry
- 620 million are energy impoverished
- Over 900 million depend on unclean cooking

Africa only contributes 4% of global energy emissions. Given this, the discussion about the just transition in Africa needs to be centred on one word- socio-economics. Africa is vulnerable to climate change because it has a very low socio-economic base. A just transition in Africa should ensure more access to resources. It should be about equity, putting food on the table, and more money in more pockets.

In addition, the just transition narrative in the African context needs to centre on Africa’s indigenous contextual understanding. 80% of the continent is actually in the informal sector. They are at the bottom of the pyramid and they need to be lifted up through:

- Ensuring that we use clean energy to add value to what they produce
- Ensuring that we leverage nature-based approaches to grow food and add value

Africa’s Agenda 2063

The supply of energy is Africa’s greatest infrastructure challenge. Many countries in the continent are experiencing power shortages, while others are

paying high premiums for emergency power supplies. As part of Agenda 2063, in July 2021, the African Union Commission launched a 5-year Green Recovery Action Plan for the continent (2021-2027).

The Recovery Action Plan (RAP) is expected to be inclusive, and respectable to the environment, and in line with the SDGs, it is also expected to create jobs in different industries and overcome challenges related to health and climate change. The Green Recovery Action Plan has 5 priority areas that require action and these include:

- Improving climate finance
- Supporting the national just transition to renewable energy
- Nature-based solutions and biodiversity
- Resilient agriculture
- Green and resilient cities

Activities in pillar 2 are aimed at supporting the implementation of the Africa Renewable Energy Initiative (AREI). In addition to the 5-year RAP, in July 2022, the commission also adopted the African Position on Energy Access and Just Transition, a plan that charts out Africa’s energy development pathway in the short, medium, and long term. According to this plan, Africa will continue to exploit all forms of its abundant energy sources (renewable/ non-renewable) to address energy demand in the continent. To accelerate energy access and just transition in Africa, some of the pillars implemented under this plan include mobilization of finance, accelerating regional integration, harmonization of policies and regulatory frameworks, and encouraging technology transfer and capacity building.

In Southern Africa, SADC member states set a target to achieve a diversified energy supply, with renewables consisting of at least 39% by 2030. In the past decade, the SADC region has been receiving \$1 billion from Development Finance Institutions such as the AfDB annually, for the production of renewable energy. The region has also been seeking to reduce its contribution to GHGs and achieve NDCs e.g. through coal divestment. A major contributor to renewable energy in this region is hydropower, with countries like the DRC, Zambia, Zimbabwe, Tanzania, Angola, Malawi, Mozambique, and South Africa being the leading contributors to hydropower in the region. South Africa and Namibia lead in solar energy

production. Wind energy still remains untapped in the region, with South Africa being the only country generating it on the grid.

In Africa, the cost of capital to establish clean energy projects is a big challenge. In the renewable energy sector, the bank’s Sustainable Energy Fund for Africa⁶ (SEFA) supports private sector investments in small and/or medium-sized clean energy projects. In addition, there is the Africa Renewable Energy Fund (AREF) which focuses on the development of small to medium-sized renewable energy projects producing between 5 MW and 50 MW.

Speaking in a webinar on “Leveraging Africa’s green minerals for the energy transition: The role of regional integration and the AfCFTA,” one of the panelists Wale Shonibare, the Director of the AfDB’s Energy Financial Solutions, Policy and Regulation Department said there is need to mobilize financial resources to accelerate the development of battery storage and the electric vehicle value chain in Africa. He also advised that leaders from top African institutions like the AU, AfCFTA should establish pan-African measures to harmonize standards, tax relief, and free trade to realize this ambition.

To what extent will this global dynamic affect Africa’s access to climate finance in the short run?

There are concerns that as a result of the Russia-Ukraine war, there could be a diversion of world leaders’ attention from climate obligations (in terms of climate finance). At the 2022 World Economic Forum that was held in Davos, world leaders acknowledged the fact that indeed Russia’s invasion of Ukraine had immensely reshaped the global energy landscape and markets. Responding to this, Fatih Birol emphasized that with the right investment, both the energy crisis and the climate change crisis can be tackled⁷. He said,

“We don’t need to choose between an energy crisis and a climate crisis - we can solve both of them with the right investment.”

In addition to that, World Bank Group President David Malpass highlighted that in this fiscal year, the bank is committed to increasing its climate finance flows. He made these remarks at the 2022 Nordic-Baltic Governors Meeting. The World Bank Group is the world’s largest financier of climate action in many African and other developing countries. He further



highlighted that the bank is committed to aligning financing flows with the Paris Agreement⁸.

At a recent climate change meeting that was held in Bonn, Germany, the chair of the African Group of Negotiators on climate change, Mr. Ephraim Mwepya Shitima from Zambia assured the stakeholders that as African nations go back to the negotiations, there is hope that the geopolitical situation will not affect the outcomes of COP27. The multilateral process in the event is guided by rules and guidelines, irrespective of the geopolitical situation, and African countries should not lower their expectations. He added that the Paris Agreement obligations guide the negotiations under the UNFCCC, and nations are committed to collectively enhancing and progressing their work under the UNFCCC⁹.

African countries, therefore, need to make sure that they get the resources so that their countries can effectively be able to respond to some of the challenges they face. Without putting the right strategies/ mechanisms in place, Africa will not be able to respond effectively to some of these challenges.

It is already evident that there is a potential risk that commitments towards achieving the climate agenda could be diversified elsewhere. Countries like Germany, which have strong commitments toward renewable energy, are taking short-term responses to address the energy crisis by exploiting coal again. It was also recently reported in the press that Italy had signed agreements to import gas from Angola and Nigeria to compensate for the energy shortfall. All this implies that the nations' plans to cut emissions and

achieve the targets agreed to at COP26 increasingly looks set to fail.

Stakeholders need to collectively work towards identifying what the solutions are and how we can make sure that even the most vulnerable members of society are able to build the adaptive capacity that they require so that they can be able to respond effectively to the impacts of climate change.

Every discussion must therefore be centred on the socio-economics of Africa. People need more food on their tables and more money in their pockets. Additionally, the discussions should shift to how we can leverage African abundance to cushion Africa against shocks; because emergencies and calamities will continue. There is a need to climate-proof Africa so that the continent can be socio-economically viable and lift its people from the bottom of the pyramid. Africa also needs to get resources to respond to challenges such as climate change.

Key recommendations for advancing the just transition and building resilience

- Need for clearly defined policy frameworks that foster closer ties with the private sector

There is a need to first recognize that there are no quick ways to solve these issues. Governments are quick to jump into big projects that do not actually benefit the people. It is important to know that the transition is a journey, understanding the socio-economic and creating the system that would actually make a difference in people's lives is a journey that does not happen overnight. This transition should be driven using an evidence-based and inclusive manner process. Many of the solutions that can address the issues lie at the local level. Africa should not translate Western concepts but rather internalize them into the African context and see how they can create those win-win situations. The Northern Cape Province in South Africa, for example, is the hub for renewable energy in South Africa but most of the local people do not have access to electricity and those with access cannot afford electricity. This is why there is a need to ensure that these projects are very inclusive, people have to be brought along, and most importantly that they are embedded in local realities.

- Prioritize interventions that empower the youth and women

Young people and women should be at the fore front of advancing the just transition in Africa. Therefore, there is need to put in place interventions that prioritize them, in both the rural and urban sectors. A challenge/ a crisis should not be wasted. Across Africa, 84% of the entire population is in rural areas, without access to energy, and grid electricity is not going to reach them. There is a need for up-grid and mini-grid to be able to reach them, and young people are supposed to intervene in that. Over 900 million of the entire African population is dependent on unclean cooking- charcoal. Turning agricultural waste into foil brisquets replaces charcoal, and can tap into a USD 20 billion market that is currently untapped. That is how climate-preneurship opportunities are created. Governments should put in place policy incentives, especially fiscal incentives like tax breaks.

- Prioritize the mobilization of domestic investment

African countries should mobilize domestic investments required for the just transition, and must not always be at the mercy of geopolitical ructions in the world. African leaders and investors must see the various opportunities of renewables and the new industrial opportunities that are presented by critical minerals and green hydrogen in the midst of this crisis. Many potential opportunities can be exploited to advance clean and climate-compatible development in the continent and these will help strengthen the African energy and food supply chains so that they remain resilient in the face of shocks and other global crises. In the energy sector, for example, the continent is richly endowed with minerals like lithium, cobalt, graphite, copper, nickel, and many other rare earth minerals that provide Africa with a unique opportunity to benefit from low-carbon, climate-resilient developments.

- Scale-up solutions that work, leaving no one behind

Scaling up can be in 2 dimensions (horizontal and vertical scaling up). Vertical scaling up is about the traditional business where one may

desire to start a massive enterprise. Horizontal scaling up is basically saying that some of the solutions required do not necessarily turn into a massive enterprise but those solutions can find traction in different communities. They can be easily replicated at scale across the landscape, regions, and communities. To achieve that, we require a culture of learning and experimenting for some of these solutions. Entrepreneurs need to recognize the value of failure. Renewable energy enterprises have been impacting the lives of vulnerable communities and the best enterprises are those that deliver energy access to villages. These, however, are enterprises that are not as attractive to investors. Therefore, scaling up requires us to appreciate the importance of localizing these interventions, appreciating the value of failing and learning from failure, and lastly being experimental.

- Capacity building in order to have adequate resources to deliver the outcomes

To promote innovation and investment toward net-zero transition, African governments need to put extra effort in building strong and efficient institutions and developing their human resources. African governments and policymakers should design inclusive climate resilience and just transition policies that contribute to socio-economic development in their nations. Many African countries are major suppliers of minerals used in renewables and electronic goods to producers in China, the U.S, and E.U. Africa needs new models focused on developing clean energy technology industries close to the sources of raw materials. That way, social-economic development is boosted in mineral-rich countries. In addition to that, innovation is a key driver for climate-resilient development. There is also a need to build the capacity of youth- the African climate army, to be the solution providers to the challenges currently faced. This is done by turning climate change problems into climate opportunities.

Acknowledgment

This policy brief was produced from a recent webinar that brought together some key thought leaders.

This is in addition to a literature review on the current geopolitics and how it is affecting Africa's just transition. The African Centre for a Green Economy would like to thank all the participants in the webinar discussion for their contributions.

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GREEN BUILDING



Practicing architectural works without being registered with the South African Council for the Architectural Profession is a criminal offence

Section 22 of the Constitution of the Republic of South Africa, 1996 grants every citizen the right to choose their trade, occupation, or profession provided that such practice of trade, occupation, or profession may be **regulated by law**;

Section 14(g) to (j) of the Architectural Profession Act 44, 2000 empowers the South African Council for the Architectural Profession to take any steps it considers necessary for the protection of the public in their dealings with registered persons, for the maintenance of the integrity and the enhancement of the status of the architectural profession, for the improvement of the standards of services rendered by registered persons, to create awareness amongst registered persons of the importance to protect the environment against unsound architectural practices, and, where, as a result of architectural related undertakings, public health and safety may be affected.

Section 18 (1) of the Architectural Profession Act 44, 2000 empowers the South African Council for the Architectural Profession to register persons in the architectural profession in certain categories. Section 18(2) strictly emphasizes that a person may not practise

in any of the categories contemplated in subsection (1) unless he or she is registered in that category. Section 26(3) also states that a person who is not registered in terms of this Act, may not

- Perform any kind of work identified for any category of registered persons;
- Pretend to be, or in any manner hold or allow himself or herself to be held out as a person registered in terms of the Act;
- Use the name of any registered person or any name or title referred to in section 18 or 21 or;
- Perform any act indicating, or calculated to lead persons to believe, that he or she is registered in terms of this Act.

The South African Council for the Architectural Profession receives a number of complaints against unregistered persons practising architecture. These matters were referred to the South African Police Services (SAPS) for further investigation and prosecution but there has been no successful prosecution. Most cases were withdrawn or closed as unfounded and/or the victims were turned away by SAPS, on the basis that the cases are of a civil



nature. Members of the Public and the SAPS need to understand that practising without being registered constitute a criminal offence.

01 July 2022, SACAP appointed an Investigating Officer to deal with cases of unregistered persons. The Investigating officer comes with 16 years of experience in policing and law enforcement. The Investigating officer's experience as a detective will assist in ensuring that unregistered persons practising architecture are arrested and they account for their criminal actions.

So far, there are approximately 32 criminal cases of unregistered persons that have been opened by the Investigating Officer. All these cases have been opened in contravention of the Architectural Act by SACAP. The Investigating Officer has been visiting victims of these crimes to take statements and physically coming to the police station around Gauteng to open cases.

Out of the criminal cases that have been opened by the Investigating Officer between July and to date, two arrests were made and the accused appeared before the Magistrate Courts. Both suspects are out on bail and will appear again before the Magistrate Court before the end of September 2022. SACAP is working closely with prosecutors to ensure successful prosecutions.

SACAP is currently arranging to present at the East and West Rand cluster meetings where more than twenty police stations will be present. The objective of these meetings is to raise awareness around the criminal contravention of the Architectural Profession Act. SACAP endeavours to ensure that no victim is turned back and that police officers understand the seriousness of this contraventions and that more arrests are made. Prosecution of unregistered persons will preserve the architectural profession and ultimately protects the members of the public.

To check if your architectural profession is registered contact SACAP on:

Tel: 011 479 500

Email: info@sacapsa.com

Demolition work on a construction site

Demolition work is defined under the construction regulations as a method to dismantle, wreck, break, pull down or knock down of a structure or part



thereof by way of manual labour, machinery, or the use of explosives. It is important for a client to include demolition work in the baseline risk assessment and client's health and safety specifications if applicable. The contractor must appoint a competent person in writing to supervise and control all demolition work on site.

The contractor must ensure that before any demolition, work is carried out, and in order to ascertain the method of demolition to be used, a competent person carries out a detailed structural engineering survey of the structure to be demolished. and that a method statement on the procedure to be followed in demolishing the structure is developed by that person. During a demolition, the competent person must check the structural integrity of the structure at intervals determined in the method statement in order to avoid any premature collapses.

Under construction regulations 14(4) the legislation requires that the contractor must:

1. with regard to a structure being demolished, take steps to ensure that—
 - no floor, roof or other part of the structure is overloaded with debris or material in a manner which would render it unsafe;
 - all reasonably practicable precautions are taken to avoid the danger of the structure collapsing when any part of the framing of a framed or partly framed building is removed, or when reinforced concrete is cut; and
 - precautions are taken in the form of adequate shoring or other means that may be necessary to prevent the accidental collapse of any part of the structure or adjoining structure;
2. ensure that no person works under overhanging material or a structure which has not been adequately supported, shored or braced;
3. ensure that any support, shoring or bracing contemplated in paragraph (b), is designed and constructed so that it is strong enough to support the overhanging material;
4. where the stability of an adjoining building, structure or road is likely to be affected by demolition work on a structure, take steps to ensure the stability of such structure or road and the safety of persons;

5. ascertain as far as is reasonably practicable the location and nature of electricity, water, gas or other similar services which may in any way be affected by the work to be performed, and must before the commencement of demolition work that may affect any such service, take the steps that are necessary to render circumstances safe for all persons involved;
6. cause every stairwell used and every floor where work is being performed in a building being demolished, to be adequately illuminated by either natural or artificial means;
7. cause convenient and safe means of access to be provided to every part of the demolition site in which persons are required to work; and
8. erect a catch platform or net above an entrance or passageway or above a place where persons work or pass under, or fence off the danger area if work is being performed above such entrance, passageway, or place so as to ensure that all persons are kept safe where there is a danger or possibility of persons being struck by falling objects.

The contractor must ensure that no material is dropped to any point, which falls outside the exterior walls of the structure, unless the area is effectively protected. The use of a chute is permitted when:

- it is adequately constructed and rigidly fastened;

- if inclined at an angle of more than 45 degrees to the horizontal, is enclosed on its four sides;
- if of the open type, is inclined at an angle of less than 45 degrees to the horizontal;
- where necessary, is fitted with a gate at the bottom end to control the flow of material; and
- discharges into a container or an enclosed area surrounded by barriers.

The contractor must also ensure that every chute used to dispose of rubble is designed in such a manner that rubble does not free-fall and that the chute is strong enough to withstand the force of the debris travelling along the chute.

Where a risk assessment indicates the presence of lead and/or asbestos, a contractor must ensure that all lead and/or asbestos related work are conducted in accordance with the Lead Regulations 2001 and/or the Asbestos Abatement Regulations 2020 respectively.

Where the demolition work involves the use of explosives, a method statement must be developed in accordance with the applicable explosives legislation, by an appointed person who is competent in the use of explosives for demolition work and all persons involved in the demolition works must adhere to demolition procedures issued by the appointed person.

Lastly the contractor must ensure that all waste and debris are as soon as reasonably practicable removed and disposed of from the site in accordance with the applicable legislation.





INFRASTRUCTURE



Service delivery – the tail wagging the dog!

Chris Campbell

As a country we are in crisis - of this there is no doubt!

Drastic change is needed in order for what was once the economic powerhouse of the African Continent, to again take our rightful place, and for this we need effective service delivery in order to provide our citizens with the infrastructure to enable economic growth leading to prosperity

To enable effective service delivery, we need efficient procurement systems that value quality, innovation, and sustainability over cost. This is of particular importance when procuring complex infrastructure projects.

Should the National Treasury be the custodians of Public Procurement?

Research will reveal that the responsibility for procurement in both the public and private sector should not reside within the ambit of finance but rather as close as possible to functions responsible for operational delivery. In keeping with many other structural reforms required to turn the fortunes of our Country around, should we too not be thinking differently about integrating the oversight role for infrastructure development and service delivery with that of procurement oversight?

Determining budgets remains the responsibility of the accounting officer, approved and monitored



by the Treasury. Delivery and subsequent reasons for non-delivery remain the sole responsibility of the entity responsible for such delivery. No fingers can be pointed away from themselves to Supply Chain Management (SCM), which does not bear the responsibility for delivery. The buck should stop there and flouting of good governance and the law in managing public funds, should be dealt with decisively and harshly.

Prof. Geo Quinot, Director of the African Procurement Law Unit at Stellenbosch University commenting on the Public Affairs Research Institute's (PARI) paper on 'Reforming the Public Procurement System in South Africa' developed in repositioning South Africa in a post State Capture context, states that public procurement is an important driver of development in South Africa, but that it is also clear that our procurement system is not particularly healthy and that this is not just a matter of corruption or state capture.

Public procurement in South Africa faces very serious systemic problems that are undermining its potential as a developmental tool and that unless we find solutions to these problems, we will continue to spend vast amounts of public funds with little to show for it by way of development.

In his analysis of the PARI report he strongly suggests moving public procurement out of its current public finance management straight jacket, into a more strategic function, that a new regulatory body should not be situated within Treasury or any other Department for that matter.

He believes that procurement is a cross cutting function and that should be reflected at the highest level in the organizational set up of a National Regulator. We have an Inspector's General for oversight in many areas and maybe it is time to consider such a role for Infrastructure Delivery & Public Procurement, capacitated of course with qualified, competent, and experienced personnel, if we are serious about changing the current narrative.

Tenders awarded based on lowest cost leads to massive Discounting destabilizing the construction industry and putting lives at risk

The second significant error is to think that you are going to get innovative, sustainable, and safe infrastructure that is designed to last, with minimal maintenance costs over its life, if you procure the services of contracted parties for planning and delivery, whether consulting engineers, other built environment professions or construction companies based purely on the lowest price without taking quality and risk into account. What we need is quality and cost-based selection (QCBS).

QCBS means the method of evaluating proposals in which the consulting engineers are ranked in order of weighted evaluation awarding minimum eighty per cent for technical proposal and up to twenty per cent for financial proposal. QCBS ensures that the most appropriate professional or firm is selected based on qualifications such as knowledge, skill, experience,

and other project-specific factors, rather than purely on fees.

Currently, the method for the procurement of our infrastructure is based solely on least cost and this has led to massive discounting of consulting engineering fees in order for these organisations to win tenders and remain viable businesses. Discounting of fees has dire consequences on both the quality of our infrastructure but also on the commercial viability of the consulting engineering industry and the broader construction industry. Both the service providers and the client bodies are at fault. The one not knowing what such quality of professional services ought to cost, with the other conceding to unsustainable professional services fees, discounted up to 50%, hoping to maintain a reasonable cashflow.

Professional service providers and consulting engineering companies, need to be united in not conceding to less than affordable, quality compromising fees, as would have been the case if



we all subscribed to the professional codes of conduct and ethics.

Likewise, client bodies, in both the public and private sectors, need to know what the lower thresholds are for deriving value for money professional services without compromising quality and increasing risk to their own projects. And yes, it is a 'fool's paradise' to assume that you can transfer ALL of this risk to the consulting engineer, who is likely remunerated at a level of 2% of the total cost of ownership of this infrastructure over its anticipated 30-year lifecycle.

What are the risks associated with the practice of Discounting and the impact on Public Safety?

In Khulile Siqiti's paper on 'The Impact of Discounting Fees by Civil Engineering Consultants', the results show that the practice of discounting professional fees is widespread, affecting small, medium, and large consulting firms. The results also indicate that prevailing market conditions in the civil engineering profession are the primary reasons why consulting engineers offer discounts on fees. Respondents agreed that projects are awarded to the lowest bidder during the tender process. Respondents also agreed that experienced engineers are allocated less time on projects to manage project costs.

The findings of Siqiti's paper suggest that discounting of professional fees is a great concern

that needs to be addressed in order to attain professional business sustainability. It is suggested that the Engineering Council of South Africa (ECSA) should regulate the fee structures and ensure that all professionals, whether employed in the public or private sector, understand the basic finances related to providing professional services for effective and efficient quality service delivery support where in-house expertise is lacking.

Any perspective that upholding a legal and regulatory function encourages anti-competitiveness, is counterproductive to the role that a statutory body ought to be able to play. These fee guidelines are actually minimum fees, so competition is encouraged to provide the quality professional services at the commensurate cost, provided that it is not below that minimum threshold.

The statutory body is after all doing so, to protect public funds while ensuring quality of professional services and sustainable local professional capacity and capability. This does not even factor in the motive that these fees are inclusive of costs for investment in training and mentoring future generations of these professionals. This opportunity is sadly lost with discounted fees.

In a paper by P. N. Okonkwo and J. Wium, titled, 'The impact of discounted professional fees on the risk exposure of the civil and structural engineering services consultants in South Africa', they state that the abolition of mandatory fee scales and the prevalence

of lowest-cost bidding for the procurement of consulting services in South Africa have seen engineering services consultants compete based on price for engineering contracts.

They go on to state that discounts benchmarked against ECSA (Engineering Council of South Africa) professional fees guidelines demanded by clients have resulted in declines in professional fees over the years. The capacity to deliver professional services that are of a high quality that meet a client's expectation, professional and ethical standards when working at low fees is one of the biggest challenges facing consulting professionals today.

A key finding of this study is that discounted fees accentuate several project level risks and create organisational level risks for the consulting engineering professional.

These results are very concerning as they not only impact the sustainability of the consulting engineering profession but also the quality of design, leaving no place for research and innovation. In addition, it has been proven that scrimping on project design has a dramatic impact over the life of the infrastructure – cheap design = higher maintenance costs and the risk of failure of the infrastructure, risking the lives of our people.

We must guard against decimating our local expertise and capacity and focus on growing 'our own timber' by developing future generations, across all races and genders and be careful not to think that we can import capacity, while hoping to maintain an affordable cost base for local infrastructure development, delivery, and maintenance.

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ENERGY



Is nuclear a potential option for South Africa in the Just Energy Transition?

Introduction

South Africa is facing a looming crisis of transitioning over the next 3 decades to a net zero carbon economy while maintaining its core economy of mining and heavy industry. These are by definition very large energy consumers and require a consistent and reliable electricity supply. Nuclear energy has shown over the last 60 years of commercial operation that it is a reliable very low carbon source of electricity with an excellent safety record. For its long-term use in South Africa however it has to answer four key questions. Is it sustainable? Is it economic? Is it affordable? Is it scalable?

Sustainable

The sustainability of a nuclear program is clearly dependent on the long term availability of fuel, the environmental impact of operation and disposal of waste.

The currently identified recoverable reserves of uranium is over six million tons globally and the

world's current usage is below 70,000 tons per year – which would appear to give some 85 years of supply. However there has been little exploration for uranium over the recent decades due to oversupply and low prices. Even if there were no further discoveries the technology of a “closed fuel cycle”, which has been demonstrated in several countries, would increase the energy extracted per ton of uranium by a factor of about 60, making the current reserves last about 5000 years.

In terms of the environmental impact of operating nuclear reactors the measurable impact has been shown to be minimal and the prospect of severe accidents with off-site consequences (such as Chernobyl) has been reduced to essentially zero with modern Generation III and IV designs. International studies have shown that the health effects (including Chernobyl etc.) and full cycle carbon emissions of nuclear power are fully comparable with wind and solar power systems, being far below that of any fossil fuel options.

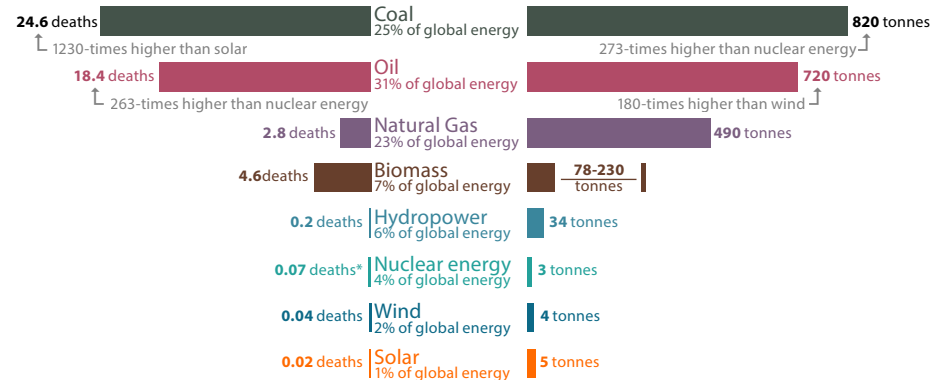


What are the safest and cleanest sources of energy?

Death rate from accidents and air pollution

Measured as deaths per terawatt-hour of energy production.

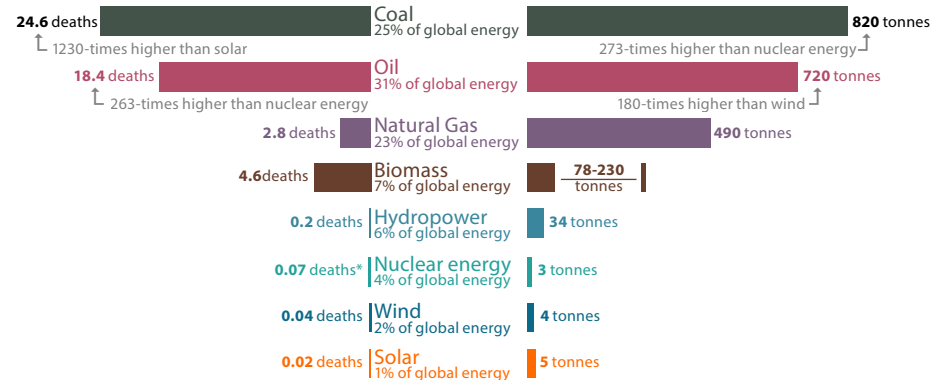
1 terawatt-hour is the annual energy consumption of 27,000 people in the EU.



Greenhouse gas emissions

Measured as deaths per terawatt-hour of energy production.

1 terawatt-hour is the annual energy consumption of 27,000 people in the EU.



*Life-cycle emissions from biomass vary significantly depending on fuel (e.g. crop residues vs. forestry) and the treatment of biogenic sources.

*The death rate for nuclear energy includes deaths from the Fukushima and Chernobyl disasters as well as the deaths from occupational accidents (largely mining and milling).

Energy shares refer to 2019 and are shown in primary energy and substitution equivalents to correct for inefficiencies of fossil fuel combustion.

Traditional biomass is taken into account.

Data sources: Death rates from Markandya & Wilkinson (2007) in the Lancet, and Sovacool et al. (2006) in Journal of cleaner Production; Greenhouse gas emission factors from IPCC AR5 (2014) and Pehl et al. (2017) in nature: Energy shares from BP (2019) and Smil (2017) OurWorldinData.org - Research and data to make progress against the world's largest problems.

Licensed under CC-BY by the authors Hannah Ritchie and Max Roseer.

The much-quoted concern over disposal of the spent nuclear fuel needs to be put in context. The spent fuel generated by a 2000MW nuclear power station such as Koeberg over its 60 year lifespan could be fitted onto a single tennis court. The technology for the final disposal of this type of fuel has been demonstrated across the industry and the first underground final repository has been licensed for operation in Finland.

Economic

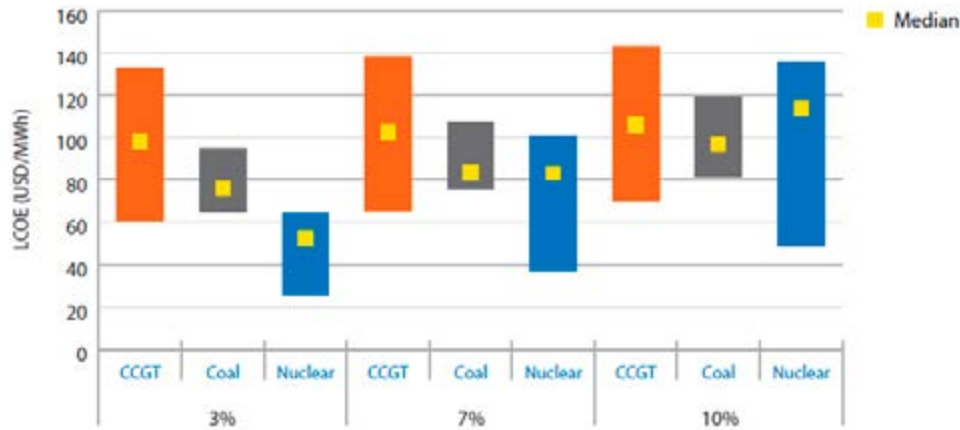
Current actual cost of construction is clearly a key factor in the cost of electricity from nuclear power.

An article published in the Financial Times 27 January 2019 by the Analysis for the Energy Technologies Institute (an organization backed by

the government and a number of energy companies) looked at 34 delivered nuclear projects around the world. This showed that while a small number of projects (less than 15%) cost over \$5,500/kWe, with some US and EU plants coming in at up to \$12,000/kWe, some 85% were below \$5,500/kWe with 40% being below \$3,500/kWe. The other key issue is clearly the real interest rate (or “Cost of Capital”) being used to obtain the funding (be it equity or loans). The current loans being provided by vendor countries to most of the export projects have interest rates of below 3% real (that is the cost of interest adjusted for inflation).

If one calculates the cost of electricity using a total capital cost of some \$5,500/kWe, a 60 year lifetime, a real cost of capital of 3% and R18 per \$1 then one gets

Figure ES.1: LCOE ranges for baseload technologies (at each discount rate)



INTERNATIONAL ENERGY AGENCY
 NUCLEAR ENERGY AGENCY
 ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT



a value of about R0.90/kWh, compared to the about R1.50/kWh from the RMIPPP bids. These bids were, unlike the REIPPP, required to provide power on a consistent basis and hence had costs some four times that of REIPPP bid window 5. Even if the nuclear plant is only given a 20 year life under these conditions the cost per kWh only rises to some R1.30/kWh.

Affordable

While nuclear power may be fully sustainable and provide economic value the key question being asked is “how can South Africa afford it”. When the 9.6GW of nuclear power was being proposed under the Presidency of Jacob Zuma there were claims that it would cost R1tn and bankrupt the country. In the recent past the pressing need to transition from a coal-based economy to a low carbon one has raised much excitement, but also some very large financing requirements. The recently released South African Just Energy Transition (JET) Investment Plan lists some

\$98bn of funding required over the next five years to begin South Africa’s 20 year energy transition.

\$98bn equates to some R1.75tn, far more than the complete 9.6GW nuclear program over a far shorter period. This, like the extensive state guarantees for the South African IPPs, demonstrates that the state has to underwrite very large sums to support the electricity system in the country.

In the case of a nuclear program these funds are sourced from the vendor countries at very favourable rates and are repaid by the operation of the plants. If one analyses the current JET proposals to de-carbonize the South African economy and compare it to the prospect of a very substantial nuclear build program to replace the current 40GW coal fleet one can clearly see that the nuclear option is very competitive and could provide a direct replacement (on the current sites) of the existing coal fired plants. This would safeguard both jobs and communities while creating a credible industry.

It would also avoid the requirement to restructure the grid system by placing the nuclear power stations on the present grid locations, unlike the dispersed renewable plants that need new grids to be built where the climate is best for them (such as the Northern Cape).

Scalable

Clearly while all the above may be a good reason to look at nuclear power as a key element to achieve the Just Energy Transition there remains the question as to whether nuclear could be deployed in the time available. The world experience shows that it can. The most famous example is probably France. They committed to their first modern reactors in 1968, being two pressurized water reactors at Fessenheim.

They were followed by four more at Bugey. In 1973 they decided to build a large number of units to remove their dependency on Middle Eastern oil. Under this process they had commissioned 40GW of domestically constructed nuclear plants between

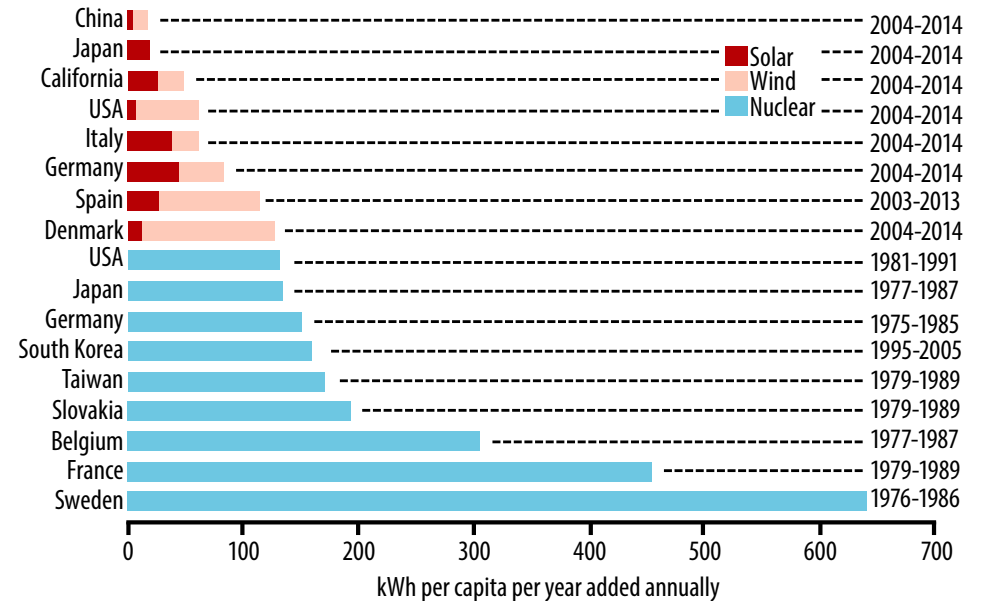
1977 and 1986. It was in many ways similar to the Eskom coal construction program in the same period.

While it is difficult to draw direct comparisons if the same process were undertaken by South Africa that could equate to the commitment to the program in 2024 with the first new unit being on line in 2033 and the complete replacement of Eskom’s old coal fleet (40GW) by 2042.

Conclusion

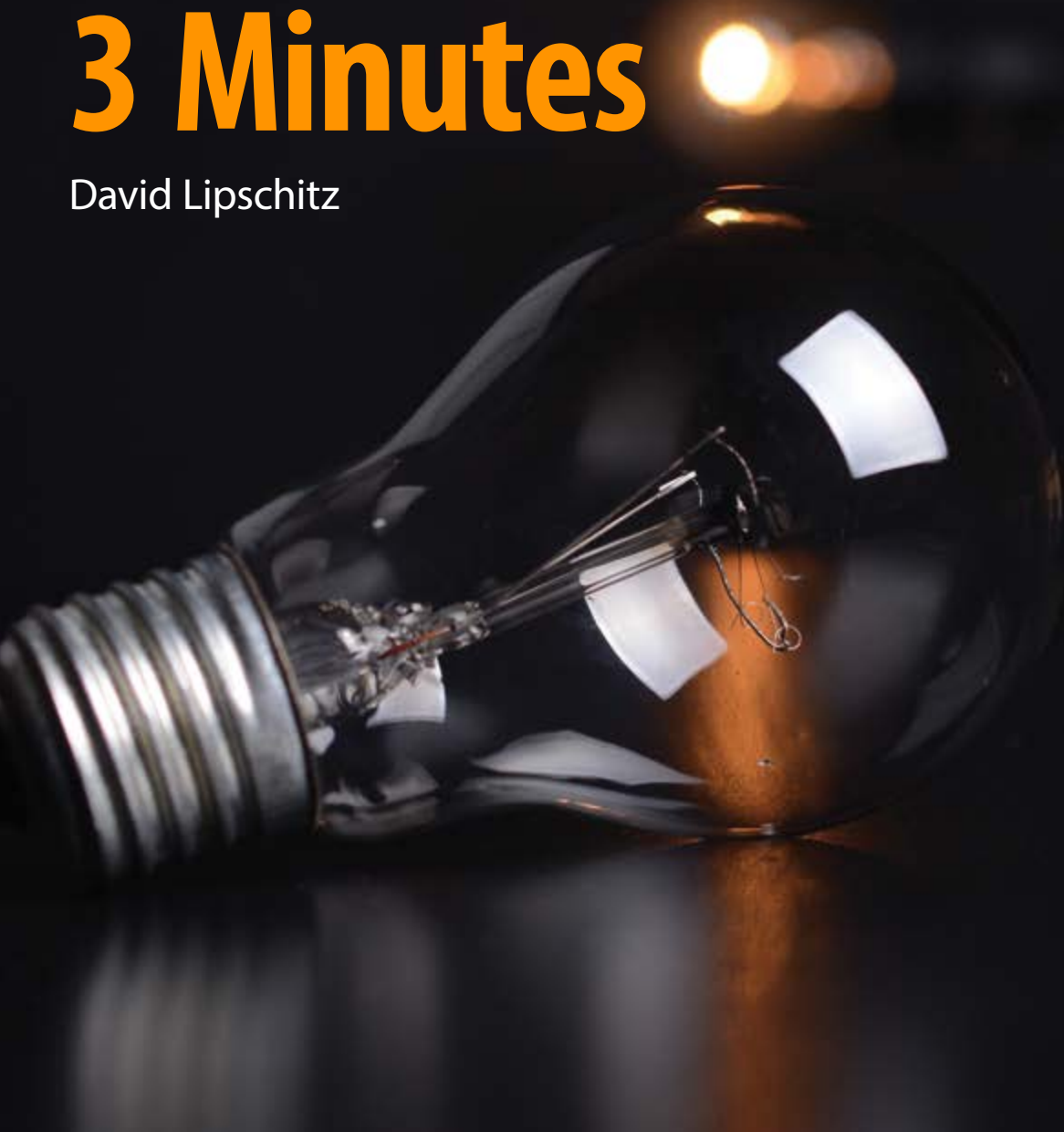
The option of nuclear power to support the required Just Energy Transition has been discounted by many people, based largely on unwarranted assumptions and pre-existing bias. In part this is due to looking to the “First World” for experience when the current best performance is in South Korea, China and Russia.

A look at the real world numbers and performance of nuclear construction being achieved in export markets leads to a belief that nuclear could play a major role in the JET and support virtually all the relevant objectives better than the current proposals.



3 Minutes

David Lipschitz



On 22nd November 2022, a troubling, but fake, message did the rounds on social media. The message said that as Eskom, a South African electricity utility, is not buying diesel for its peaking power stations, South Africa will hit a nationwide blackout on 9th December 2022. 9th December has been chosen as it is after the Matric (final year of school in the South African system) Examinations, and a reactor at the Koeberg Nuclear Power Station is being switched off for several months of maintenance.

The message was fake, but where there's smoke there's fire. I'm reminded of two books I've written.

The first is called "The Last Blackout". I spent most of May 2022 working on a new strategy for showing people how important electricity is and for showing companies how they can reorganize their payroll systems to take advantage of ESG (Environment, Social and Governance) and how companies can incentivize their employees and stakeholders to become part of the solution in the electricity, water and transport spaces. The <<YourSuburbHere>> or <<YourOrganisationHere>> MicroUtility comes to mind, as an example.

Then at 12.30 am on Wednesday 25th, I awoke, and within minutes realised that I must type what I was thinking into my phone. This continued until 6.30 am. I loaded what I had written into Scrivener, the app I use to help me write books. I had started using the Notes app for almost everything, "spreadsheets", notes,

and thoughts, and now I use one phone app instead of about 5 apps. Maybe not as easy to summarise, but very quick to enter, and when I sell a book, for example, I make a note of it on my Notes app and when I'm ready I simply count the different books I've sold or given away. It's my newest CRM system, with no monthly fees, and no unnecessary complexity. This aside probably wasn't what you were expecting in an article on Energy, but it explains how my mind works, and why I am an outlier and disruptor, finding paths because of signals I hear amongst the noise of life.

After copying and pasting my download into Scrivener, I realized I had the start of a thriller, and I had typed 8,000 words into my phone! I still had a lot of work to do, but when I realized that it is written in the future, it set a perfect scene for me to show potential future scenarios. It gave me the beginnings of a new plan, something that I have spent years working towards, which shows people how important electricity is and how quickly our 21st Century Systems collapse if we don't have electricity. If we don't have electricity, we don't have communications, banking, internet, fibre, fuel for our vehicles, no phone calls, and other necessities. Very soon the food and liquids in our fridges and freezers go off. We don't get water as the water, in Cape Town's case, is pumped from a dam 100 km away. And pumps need electricity. The sewage system stops working as city-based sewage systems depend on water to operate. We are told that we only need 5 litres per person per day, but there is a much bigger picture. Water is needed to run the

sewage system. It is needed for plants and vegetables and animals and our food production system. Water is a lubricant. Water has hundreds of uses.

Raw sewage flowing in our streets is a health risk, worse than a single pandemic, and medieval and "dark ages" diseases such as Cholera, Typhus, Typhoid, Bubonic Plague, and so many more become a real threat in only 2 to 4 days after the electricity is switched off.

How much backup water do people have? In places like Cape Town, people and organisations have water backup. Perhaps this will last people a few days, or maybe a lot longer for those who have invested in local sea-based desalination plants, for example.

4 million people in Cape Town looking for water, and food, and trying to avoid smelly streets, is a nightmare. And what of centralized water stations? How does one carry a 25-litre water container? Picture how difficult it is to transport a suitcase across a railway station or airport concourse, and suitcases are made to be transported. 25-litre water containers are much more difficult to move around, usually from a spring to the boot of a car. And if one gets a 25-litre water container at a central water collection point, gangs might steal the water as you drag the containers to your house. Not a pretty sight.

I ask people "what is your highest priority in the next 3 minutes?" Most people immediately answer "air". Correct answer. I then ask, "what's next". I usually get "water", but before water, one needs clothing to protect one's body against the cold or heat or unfriendly people, and then one needs a safe place to sleep. Only the next morning does water become essential, for helping one to brush one's teeth, for drinking, and then for flushing the toilet and rinsing the dishes. With no water, we run out of cutlery and crockery and glasses and cups, which pile up in the sink, and in mid-summer (9th December is summer in South Africa, and it can be 30 degrees Celsius), ants and other "pests" will want to come and visit.

Only after water does one need food and transport and other necessities. Water, transport, food, and communications all depend on electricity and in the 21st Century, after air, the second most important thing we need in one of the 512 cities in the world with more than 1 million people, is electricity. 512 cities with more than 1 million people must have electricity. It is essential for life for these billions of people.

As part of The Last Blackout, President "Sibongile" comes to my house. He asks me "how did you know" how to prepare. I take the President down memory lane where I explain how the bad (and good) things that happened to me during my life gave me guidance as to whom I was going to become. My book has already helped a reader get perspective and lifted him out of his depression.

In 2020, I published "A User Manual for Life on Earth." This book shows people how I would run the planet, which is an alternative way of saying how people should run their lives, by getting rid of the mundane things we worry about.

If air is one's most important requirement, then one wants air that is clean, not polluted. Realising that air is our main requirement causes us to realise that our energy and food and transport and all our systems must be environmentally friendly. Realizing that good quality air is essential for life, causes us to realise that we must plan for decades in our planning so that we

can make ourselves as healthy as possible by keeping our immunity up by keeping invaders out of our bodies. We are lucky to live in an age of pharmaceuticals and vaccines, but we would be even luckier if our systems were such that we didn't need to load our bodies with even more chemicals after they have already been loaded with so many chemicals and toxins and dioxins, causing cancers where the body eats itself.

The body eating itself is a simile for the earth eating itself. Humans are literally eating the future, and environmentalists and scientists say that we are consuming 3-earths right now and we are hitting all kinds of limits. These crises include environmental, food, transport, energy, water, and knowledge management.

The result of these crises is high inflation with people being unable to pay for the basics of electricity, water, and food.

Changing our outlook means that we shouldn't have spent billions of dollars on holiday-type places.

We should be on holiday all the time. Our work should be a holiday. Imagine if all those dollars had gone into making clean, efficient, abundant, and clean energy systems. Clean water, air, transport, and food.

Immunity boosters. Healthy bodies. Healthy minds. Healthy communications. Healthy communities.

Our general thinking about "today" leads us to miss the big picture of where all this stuff comes from and how we, as consumers, should fix our supply chains by demanding higher quality, more abundant, and less expensive products.

Thinking about what you need in the next 3 minutes will change your life and it will change our earth.

I'm available to speak to you or your organization directly or virtually and take you through this thinking as a keynote, or conference speech or workshop. In the meantime, I've made my books inexpensive, and you can find them on Amazon and Smashwords and you can buy them directly from me in South Africa.



Energy liberalisation to raise the country's energy availability levels

South African Wind Energy Association

Having exceeded the 150th day of load shedding this year, South Africa's economy continues to feel the strain of the energy availability factor (EAF), which is not able to reach the required levels. The South African Wind Energy Association (SAWEA) acknowledges that whilst the problem is simple, developing solutions for the energy crisis is complex and requires the right expertise for planning.

At the heart of the plan, the Association is advocating for 'Energy Liberalisation' underpinned by a number of mechanisms. Specifically, Demand Side Management (DSM), where new generation capacity, for own use, must be considered as a mechanism to reduce demand and increase supply.

"We believe that whilst the Electricity Regulation Act (ERA) amendment bill is the right policy

intervention to support a liberalised energy market in South Africa, the removal of the license requirement for own use projects will not have the desired outcomes if not implemented efficiently and effectively," explains Niveshen Govender, CEO of SAWEA.

He adds, "Policy alone is not enough, we must manage and improve the bureaucracy of the process required to build new generation capacity and renewable energy capacity specifically."

The Association believes that there needs to be more and better coordination between stakeholders and that political will and regulatory frameworks should be forthcoming. The industry is calling for a clear, transparent and documented process to guide a number of blockages to delivering new generation.

"Our industry needs grid connection application, and wheeling conditions need to be standardised

and finalised nationwide; as well as permitting requirements and processes that are accessible and practical," says Govender.

Acknowledging that energy solutions will largely be funded privately, typical investor conditions should be encouraged to create investor confidence.

Private Power Purchase Agreements (PPAs) is new territory for South African Independent Power Producers and at this point still represents a fairly high risk for the producers, with contention around risk allocation between parties.

"Once we have the first few projects over the line, the industry will be able to iron out a number of the issues at play, but as it stands the industry needs to unpack a number of requirements for the private off-take market to achieve bankability," concluded Govender.



Inclusivity of SMMES and empowering them with knowledge of new energy resources and capability is key

Aradhna Pandarum



Energy transition isn't just a new concept; it is loaded with novel technologies being introduced at an unprecedented scale" - Aradhna Pandarum

My passion for the energy transition space has its roots in touching lives through innovation. Developing new capabilities and innovation platforms to meet local energy transition objectives is an agenda priority both for me personally and for the Global energy industry. Collaboration and innovation are key to producing better efficient designs faster. By adopting engineering simulation and test solutions, energy businesses can accelerate development turnaround time and output levels.

Effective relevant energy transition mechanisms ensure that the selected, resilient low-carbon energy technology streams not only address current energy shortages but also contribute to a just society by improving the country's employment rate, economic growth, and inclusiveness.

The current business challenge is a global one and is brought about by climate change with the increasing need to reduce greenhouse gas (GHG) emissions. According to a report published in 2021 by Bloomberg, South Africa is the 12th largest source of GHG emissions globally. Almost half of these emissions emanate from the electricity sector. It is therefore prudent for us as a country to transition to low-carbon energy technologies and in so doing ensure accurate relevant analyses of all contributing streams to this dilemma so that swift mitigation of risk responses can be factored in.

The energy transition isn't just a new concept, it is loaded with novel technologies being introduced at an unprecedented scale impacting and affecting pathways that have a direct effect on environmental, social, and economic indexes.

Techno-economics have always been central to the investment and implementation of large infrastructure for any successful energy technology platform. However, social justice facets such as job creation, enterprise development, community participation, upskilling, reskilling, skills development, and impact on health, and overall livelihood is pivotal to ensuring that the energy transition is JUST.

The time is rife for local pioneering especially after the impacts of COVID-19. The correct and attuned implementation of relevant solutions will be beneficial in alluring energy industry support programs that will echo an expository narrative showcasing insights into the local success of energy transition.

Current market challenges in the energy space include:

- Job losses from the coal sector due to lack of upskilling or reskilling,
- Salary and Job description implications created by low-carbon technologies including renewables and green hydrogen,
- The holistic social impact (and how to best determine the impact) of decommissioning coal-fired power stations and using the correct risk mitigation solutions that can be used to address these impacts,
- The current inability to ensure and quantify inclusivity, enterprise development, and increased economic growth including unforeseen delays in

the procurement processes to purchase new energy technologies.

These are but a few challenges however a solution on the table is to expedite the energy transition process, whilst ensuring social justice imperatives, by directly addressing enterprise development through empowering SMMEs in the energy sector.

An injection of astute acumen into a plethora of energy transition opportunities is available to them coupled with technical expertise that will certainly act as a resilient springboard for SMMEs on this exciting low-carbon energy journey. I am confident that this intuitive intervention will ensure significant economic growth. SMMEs employ 50-60% of the SA workforce and SMME inclusion will have an impact on reducing unemployment.

Unbeknown to many stakeholders, policy recommendations and alterations are continuously being made behind closed doors with the chief intent to drive economic growth and sustainability.

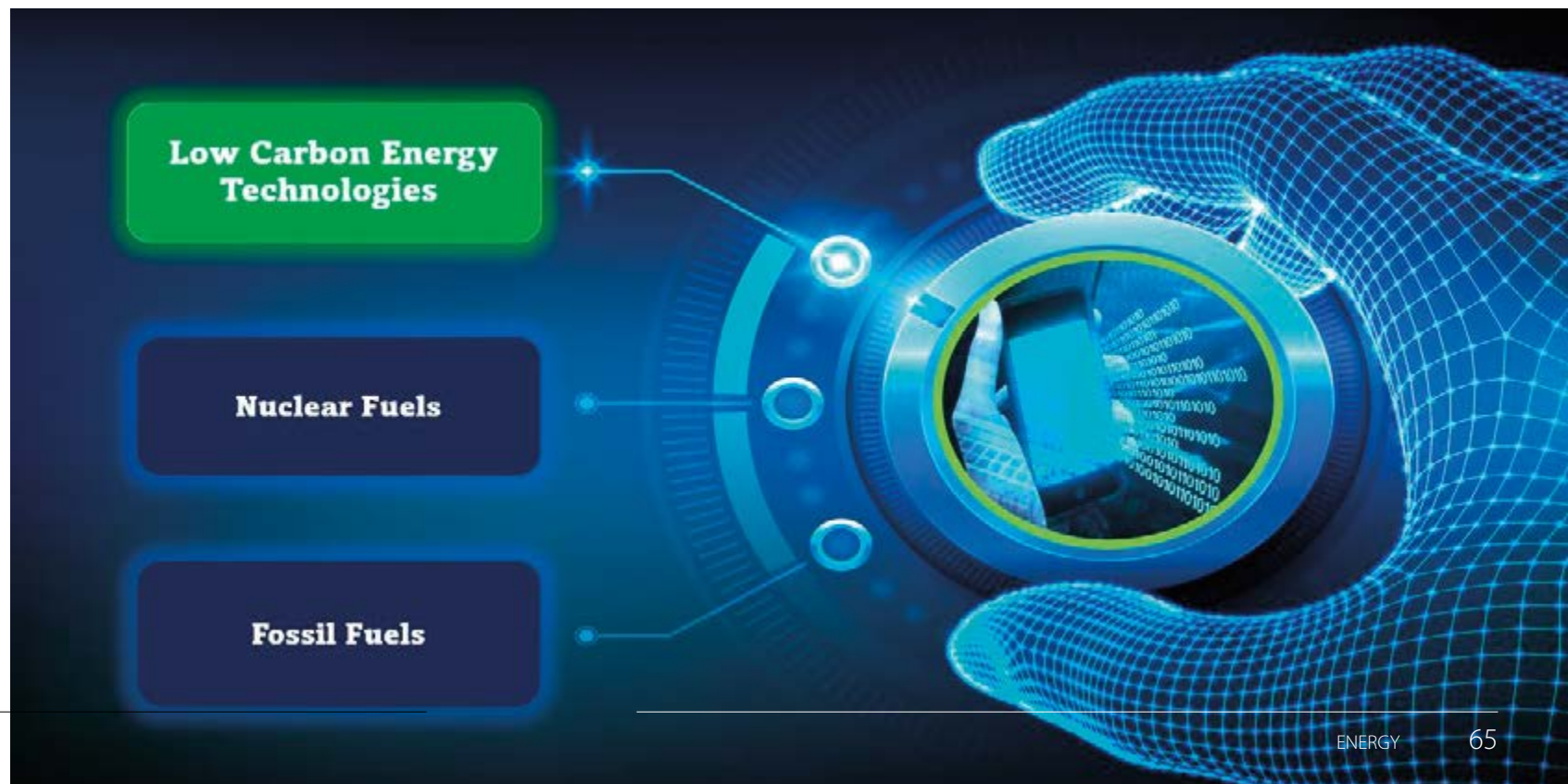
SMMEs are not privy to this crucial information and are generally unaware of the opportunities being created and available to them.

Analysis conducted by the CSIR in Pretoria concluded that by 2030, 46219 jobs will be lost by the decommissioning of coal-fired power stations but the implementation of the low carbon energy technologies in the integrated resource plan will result in a net increase of 34997 jobs (indirect and direct).

However, the jobs will not be created in the same areas that they are lost and furthermore, the quality and sustainability of those jobs are still to be understood.

This indicates that the resulting electricity sector will not be enough to make up for all jobs that are lost, let alone cater to market-related salaries at that time. Other economic diversification options cannot be ignored and must be explored speedily.

Therefore, empowering SMMEs through collaborations are critical to ensuring a just energy transition.



Repurposing of coal-fired power stations and coal mines for a JUST transition in South Africa

Aradhna Pandarum, Boitumelo Tlokolo, Abram Marema, Tshwanelo Rakaibe and Donah Simiyu.

Introduction

Since the dawn of the industrial revolution, humans have been extracting large amounts of fossil fuels and burning them indiscriminately in pursuit of economic growth and higher standards of living (The New York Times, 2018). South Africa is the world's 13th largest emitter of greenhouse gasses and is heavily reliant on ageing coal-fired power stations for its electricity (Global Carbon Atlas, 2020). Climate changes are being driven as a consequence of this paradigm and a consensus has formed around the need for an energy transition both globally and in South Africa. However, this transition needs to be "just" and align with the National Development Plan (NDP) which envisages that the country will move towards a 'low-carbon, climate resilient economy and just society', with a reduced dependency on carbon intensive energy sources.

Globally, countries are phasing out their coal use in various linked sectors such as electricity, mining, logistics, manufacturing, and export. These countries are taking different approaches to diversify their economies and energy mixes predominantly due to pledges to reduce greenhouse gas (GHG) emissions (Jedy-Hugo et al., 2021). South Africa's Integrated Resource Plan (IRP) 2019 determines that approximately 10.6GW will be decommissioned by 2030 from coal-fired power stations in the province of Mpumalanga having direct implications on the entire coal value chain, especially the mining industry currently supplying coal to these power stations. The subsequent closure of both coal power stations, and coal mines will have negative socio-economic impacts, and these impacts will significantly

affect the regions where coal continues to play a significant role in employment and economic growth (Strambo et al., 2019). Without proper planning, it is expected that substantial economic losses would be incurred by the South African economy and society at large with further potential to trigger social unrest and violence.

To mitigate the possible negative effects associated with this, this article proposes several repurposing solutions that have the potential to bring about new economic opportunities.

Methodology

A literature review was completed to identify aspects that should be considered to have an effective and just transition when considering repurposing for coal mines and power stations. This review also included possible repurposing options and identification of all coal value chain elements and linkages to other sectors.

Stakeholder engagements with the local research community and European institutes influenced the list of repurposing solutions for coal mines and coal power stations for detailed analysis. These solutions were narrowed down further by the CSIR researchers and various energy experts internally and externally using a multi-criteria decision analysis (MCDA) that was developed based on inputs from technical experts and literature. Prioritization of each criterion and sub-criteria was categorized by technical experts. Finally, the application of the MCDA recommended the top six most suitable repurposing solutions for both coal mines and coal power stations. The details and results for the

analysis and conclusions are presented in the sections to follow.

Literature review

Just transition research mapping

This section details the findings from the literature review and stakeholder engagements conducted that aimed to determine what criteria should be considered when identifying options to be pursued for a just transition. Historically, projects and technology selection were based on technical feasibility and pure bankability, however, this narrowed and simplistic approach cannot ensure a just transition.

A desktop literature review was conducted for the international and local just transition landscape. The aim was to understand the aspects considered when carrying out a just transition, identify research gaps and make recommendations. On the local landscape, 28 studies were reviewed emanating from research organizations, companies, institutions, national departments and funders. A high focus,

96% of the studies, was placed on environmental aspects including high emissions and commitments towards their reduction. 86% of the studies focused on economic aspects such as sustainable and quality jobs, economic diversification and skills development. However, social and technical/costs considerations received the least focus with approximately 54% and 39% of the studies, respectively. It was also noted that the studies focused more on aspects at national level, rather than having a regional focus.

19 international studies were reviewed for the international just transition landscape and it was found that these focused more on regional levels and included case studies and lessons learnt from transition efforts. 100% of the sourced studies highlighted the economic dimensions, followed by social aspects such as social protection plans and community participation/consultations. Environmental and technical/cost aspects received the least focus from the studies, with only 5% of the studies focusing on technical/costs. The aspects considered within these various dimensions are summarized in Figure 1 below.

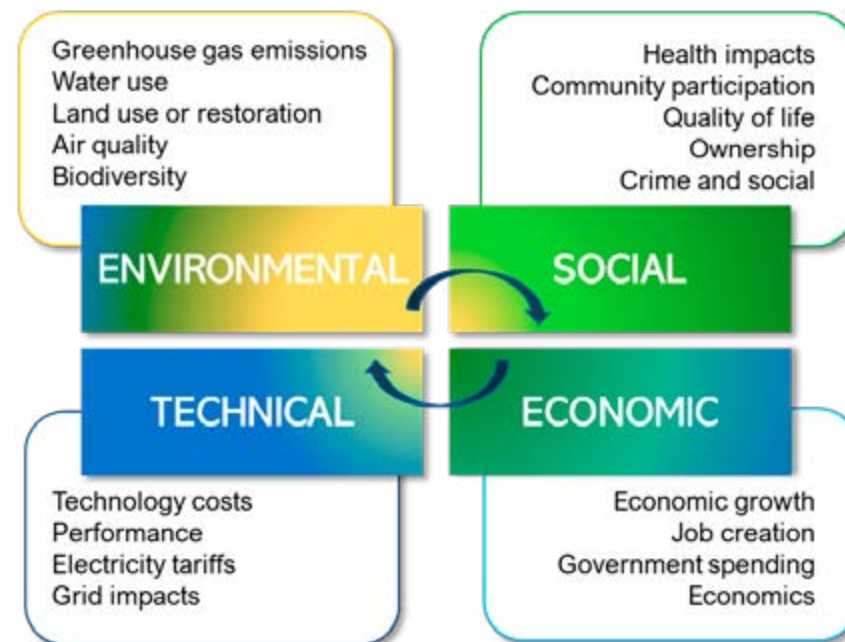


Figure 1: Dimensions and associated aspects considered for selection of pathways and projects for a Just Transition (CSIR Analysis)

The studies reviewed from a local perspective illustrated that there is significant focus on environmental aspects, whereas international research emphasized economic aspects. The gaps highlight the need for more attention to be given to social imperatives. Furthermore, the research addresses a national focus but lacks a regional analysis.

High-level screening of repurposing options

Various countries undergoing coal transition have repurposed their coal-fired power stations and coal mines as listed in Table 1. In this study, the implemented repurposing solutions are screened at a high level in the international and local context. A summary of the reviewed repurposing solutions internationally and locally for coal power plants and coal mines is given in Table 1 below along with the citations.

The review of implemented and proposed repurposing options for coal-fired power stations and coal mines brings out economic, technical, costs, environmental and social dimensions that were considered when selecting the options. Important

aspects include re-use of existing infrastructure and access to private and state funding which have enabled timeous implementation of international repurposing projects in the US and EU. Renewable energy such as biomass can reduce emissions and create long-lasting jobs as compared to wind and solar PV. However, sourcing of biomass from forests makes the strategy “unjust”, calling for more assessment. The review also brings out the importance of community engagement before development to understand and meet the needs of the surrounding community. Support for locals is also demonstrated through jobs, small, medium, and micro enterprise (SMME) support, grants, skills development and the use of locally manufactured raw materials. In South Africa, repurposing of Komati coal power station is planned in 2022 and includes installing solar PV, battery storage, synchronous condenser conversion, wind turbines and agrivoltaics (Eskom, 2022b). 300,000 jobs can be created by the project which will also supply electricity to off-grid areas. A training center at Komati will help to train workers and local community members.

Table 1: Implemented/in process solutions reviewed for repurposing of coal mines and coal power stations

Repurposing option	Location (status)	Dimension/aspect
Coal power stations		
Combined cycle gas turbines (CCGT)	Paradise combined cycle Gas power plant, France - Complete) (Power, 2017)	<p>Economic:</p> <ul style="list-style-type: none"> Job creation - 600 construction jobs; 40 permanent and 20 contractor operational jobs <p>Technology/costs:</p> <ul style="list-style-type: none"> Use existing coal infrastructure Increasing efficiency 62.22% Quick response to grid demand fluctuations <p>Environment: 50% emission reduction. Social: electricity for 600,000 households</p>
Biomass firing	Redbank Power Station, Australia (Stalled due to claims of forest destruction, Environmental impact assessment ongoing) (Vatala et al., 2022)	<p>Economic:</p> <ul style="list-style-type: none"> 265 jobs during recommissioning, 55 permanent jobs, 800 – 900 direct and indirect jobs form the fuel supply chain <p>Technology/costs:</p> <ul style="list-style-type: none"> Use existing coal infrastructure <p>Environment: Net Zero CO2 emissions</p> <p>Social:</p> <ul style="list-style-type: none"> Improved air quality Lasting jobs over 30+ years Electricity to about 250,000 homes

Battery energy storage	Mount Tom Station in USA (Complete) (Teale, 2019)	<p>Economic:</p> <ul style="list-style-type: none"> Revive dying economy Stable electric rates <p>Technology/costs:</p> <ul style="list-style-type: none"> Use existing infrastructure <p>Environment:</p> <ul style="list-style-type: none"> Eliminate generation emissions Preservation of close waterways Protection of rare and endangered habitats <p>Social:</p> <ul style="list-style-type: none"> Slow down deteriorating health issues Youth employment and re-training Early access to retirement packages Community engagement
Mixed-use development	Battersea power station, UK - leisure, retail and residential areas (To open in October 2022) (Battersea powerstation, 2021)	<p>Economic:</p> <ul style="list-style-type: none"> Invested about £9 million in local SMMEs Committed to filling 20% of its long-term positions with locals Created Battersea Academy for Skills & Employment (BASE) <p>Technology/costs:</p> <ul style="list-style-type: none"> Use existing infrastructure <p>Environment:</p> <ul style="list-style-type: none"> Diverted 5,889 tyres for flooring works and saved 36,000 tons of emissions <p>Social:</p> <ul style="list-style-type: none"> Community engagement
Data center	Widows creek, USA (Completed) (Gammons, 2015)	<p>Economic:</p> <ul style="list-style-type: none"> ~100 full-time and contractor (plus local) jobs Training locals in digital skills <p>Technology/costs:</p> <ul style="list-style-type: none"> Use of existing electricity infrastructure <p>Environment:</p> <ul style="list-style-type: none"> Preservation of existing terrain Uses 50% less energy than comparable data centers <p>Social:</p> <ul style="list-style-type: none"> School and community grants Increased provision of global internet services
Green hydrogen hub	Moorburg power plant, Germany (Ongoing) (Hydrogen Central, 2022)	<p>Economic:</p> <ul style="list-style-type: none"> Proximity to potential hydrogen market hence project can cover entire value chain Create ~5.4 million jobs Generate €800 bn annually in sales by 2050 <p>Technology/costs:</p> <ul style="list-style-type: none"> Use existing gas network and grid connection <p>Environment:</p> <ul style="list-style-type: none"> Reduce CO2 emissions by one million t/yr by 2030

Repurposing option	Location (status)	Dimension/aspect
Coal mine repurposing		
Pumped hydro energy storage (PHES)	Kidston Gold Mine, Australia (ongoing) (Colthorpe, 2021; Power Technology, 2022)	<p>Economic:</p> <ul style="list-style-type: none"> • Generate AUD 353 million in revenue • 500 jobs and 20 permanent operational local jobs • Stable energy supply/meet peak demand <p>Technology/costs:</p> <ul style="list-style-type: none"> • Use existing mine pits for water storage • Reduce peak power prices <p>Environment:</p> <ul style="list-style-type: none"> • Land rehabilitation <p>Social:</p> <ul style="list-style-type: none"> • Cheaper and stable electricity for people
Solar PV plant	Leipziger, Germany (Complete) (Enkhardt, 2022)	<p>Economic:</p> <ul style="list-style-type: none"> • Area revitalization • Use of locally manufactured materials • Potential for agrivoltaics <p>Technology/costs:</p> <ul style="list-style-type: none"> • Use of existing grid infrastructure • Grid tied project <p>Environment:</p> <ul style="list-style-type: none"> • Less environmental contamination after re-soiling • Reduces ~3,700 tons of CO2 emission • Improved regional water quality <p>Social:</p> <ul style="list-style-type: none"> • Electricity supply to 1800 households • Improved quality of life after mine cleanup
Data center	Lefdal mine, (Complete) (LDM, n.d.)	<p>Economic:</p> <ul style="list-style-type: none"> • \$164 million direct economic impact during construction • 225 direct operational jobs annually <p>Technology/costs:</p> <ul style="list-style-type: none"> • Use of existing underground mine terrain • Sea cabling from RE power source <p>Environment:</p> <ul style="list-style-type: none"> • Conserved energy due to nearby cooling water and water re-use • Use RE from hydroelectric and wind sources
<p>Leisure areas:</p> <ul style="list-style-type: none"> • Hotel • Eco-tourism park 	<p>Shenkeng Quarry, India (Complete) (Katyal, 2018)</p> <p>Anglesea mine, Australia (ongoing) (Eden Project, n.d., 2019)</p>	<p>Economic:</p> <ul style="list-style-type: none"> • Use of locally manufactured materials (Shenkeng) • 5000 workers during construction (Shenkeng) • Generate AU\$350m within 10 years (Anglesea) • 1,300 new mostly local jobs within 10 years (Anglesea) <p>Technology/costs:</p> <ul style="list-style-type: none"> • Use of existing infrastructure (Shenkeng) <p>Environment:</p> <ul style="list-style-type: none"> • Nature preservation (Shenkeng) • Powered by RE sources (Shenkeng) • Nature creation/biodiversity preservation (Anglesea) <p>Social:</p> <ul style="list-style-type: none"> • Community engagement (Anglesea) • Uplift young people and school groups (Anglesea) • Affordable housing (Anglesea)

Learnings from international experiences can ensure “just” repurposing options for South Africa.

Regional profiling and identifying sector linkages between coal and other value chains

Existing coal value chain in the region and its linkage to other sectors

This section identifies stakeholders within the coal value chain in Mpumalanga who will be most impacted by the repurposing of coal mines and power stations. The objective of this analysis was to inform the socio-economic and industrial risk and vulnerability assessments of transitioning to a green economy. The coal value chain includes manufacturing, mining operations, transportation and storage of mineral and manufactured products, power generation, coal-to-liquid synthetic fuel production, energy feedstock in the manufacturing sector and coal export (see Figure 2 below).

Details on the main value chain element is provided below:

• **Coal mining operations:** According to 2021 Eskom’s report, SA produces an average of 224 million tons of marketable coal annually, positioning the country as the fifth largest coal producer in the world (Eskom, 2021a). In 2021, South Africa’s coal production contributed a total gross value added (GVA) of ~R85 billion with Mpumalanga accounting for a share of ~86.2% (Quantec portal, 2022b). This is associated with a total employment of ~100 000 workers, with Mpumalanga accounting for ~82.6% (Quantec portal, 2022a). The economic and social reliance on coal mining operations is evident for the country but more specifically, Mpumalanga. Coal producing areas are predominantly located in Emalahleni, Steve Tshwete and Govan Mbeki municipality jurisdictions which, combined, accounted for

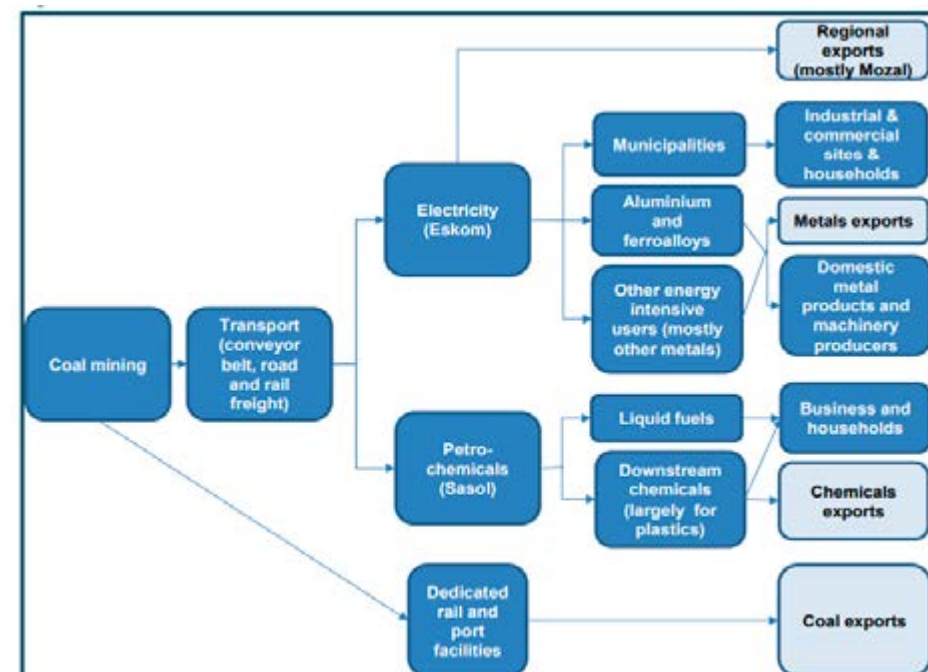


Figure 2: Coal value chain (source: Makgetla and Patel, 2021)

82% of the gross value added of provincial coal production (EasyData/Quantec, 2022). Reserves are running low, and future coal mining activities will move northwest to Waterberg and Soutpansberg, which account for 72% of the remaining supplies (Creamer Media, 2015; Mathu, 2014).

- Coal transportation and storage:** The transportation of coal to coal fired power stations, predominately utilizing conveyors, road and rail transport, has increased over the past ten years (Strambo et al., 2019). Beneficiation and manufacturing facilities also have coal delivered via conveyor belt, rail and road transportation (Makgetla & Patel, 2021). Furthermore, the transportation of coal has contributed significantly to the transport sector through creation of employment and revenue (Strambo et al., 2019). Mpumalanga houses the most coal resources in the country with 90% of the coal mines located in this province. Subsequently most of the coal fired power stations have been strategically located to these mines in order to reduce substantial transportation costs and further serve most of the electricity demand of the country which is also located in the central and Northeast regions. The substantial cost of transporting coal has directly contributed to continued coal mining in the Mpumalanga province and indirectly supported other coal producing regions such as Limpopo province. Road is the preferred mode of transport for delivering coal from other coal producing regions to coal fired power stations in Mpumalanga (Mathu, 2014). About 57 per cent of the distance travelled by heavy freight occurs on roads that are not constructed for heavy vehicles. Long-distance bulk transport of coal bound for export is predominantly rail-based using the Transnet Freight Rail network to the Richards Bay Coal Terminal (Botha, 2016). Overall, the transport and storage sector accounted for 5 per cent of GVA for Mpumalanga.
- Coal-fired power generation:** The electricity generation capacity in the country is mainly dominated by Eskom (South African state-owned power utility) (Baker & Phillips, 2019; DPE, 2022). Eskom is a vertically integrated monopoly (DMRE, 2021; Eskom, 2021b; Kessides, 2020). Eskom's total nominal capacity of ~46.7GW is dominated

by 15 coal-fired power stations accounting for a proportion of ~38.8GW (83%) (Eskom, 2021b). Twelve of these power stations are located in Mpumalanga province and have a nominal capacity of ~27.9GW (Eskom, 2022a). In 2021, 91.1% (183.6TWh) of the total energy production was from coal fired power stations. Mpumalanga accounts for 76% of the total electricity generation in SA (Nyamadzawo, 2021). At municipal level, electricity production from local municipalities Emalahleni; Steve Tshwete and eHlanzeni account for 78% of the provincial total for electricity. From 2000 to 2020, the contribution of electricity production from coal-fired power stations to the provincial GVA experienced a decline of 2%. Notable reductions were from Pixley Ka Sem; Lekwa; Dipaleseng; Emalahleni and Steve Tshwete municipalities. The electricity GVA of Msukaligwa and Mkhondo municipalities has increased indicating some growth in related economic activities.

- Manufacturing sector:** Apart from coal providing primary energy needs for electricity, it also serves as valuable feedstock for energy in the manufacturing industries such as petrochemical, iron and steel production, non-metallic minerals, cement, and lime calcining, among others. ~53% and 33% of locally produced coal are attributed to the petrochemical and metallurgical industry, respectively (Eskom, 2021a). Sasol, the largest producer of petroleum chemical products, has a coal to liquid (CTL) plant in Secunda, Mpumalanga where it produces 25% of SA liquid fuel supplies (petroleum in particular) (Makgetla & Patel, 2021). Major manufacturing industries including petroleum, chemical, metal, machinery, and equipment contributed a significant share of ~42% to South Africa's total manufacturing GVA in 2021 (Quantec portal, 2022b) Similarly, the same industries accounted for ~64% of Mpumalanga's total manufacturing GVA in 2021. Govan Mbeki's local municipality is an economic hub producing petroleum products which contribute 62% to the provincial petroleum refining GVA. Furthermore, it is an important economic activity in Albert Luthuli municipality accounting for 20% of the GVA. Key manufacturing centres for transport equipment include Ehlanzeni; Mbombela and Emalahleni where the GVA contribution from

them to the transport sector was 71% in 2020.

- Export sector:** Over the past ten-years, the coal export sector has successfully recorded an average annual growth of ~10.6% (Quantec portal, 2022b). This is partly attributed to coal and energy intensive industries such as petroleum, chemical, rubber, plastics, and metal refineries including iron and steel, non-ferrous and structural metals. Notably, these industries collectively accounted for ~22% share of GVA contribution to export sector in 2021 (Quantec portal, 2022b). Mining and quarrying and manufacturing sectors accounted for 47.2% and 46.8% share of contribution to export sector in 2021, respectively. Furthermore, ~25% of coal production is exported internationally and making SA the third largest coal exporting country (Eskom, 2021a).

Risk and vulnerability assessment for the most affected parties in coal value chain

The next part of the project was to establish a clear understanding of the most vulnerable parties in the coal value chain. This enables more specific and practical assessment of the needs of the most vulnerable parties and alignment with resources. Furthermore, it allows for the most protective implementation plans possible (Makgetla & Patel, 2021).

Communities, workers, and small business have been identified as the most vulnerable in the value chain. Workers and small businesses are direct participants in the coal value chain by being employed and supplying goods and services to coal mining firms, coal-based power generation, and coal-based petrochemical production, respectively. The vulnerability of coal mining workers is mostly triggered by limited access to financial resources, limited mobility in the labour market and relatively low level of skills (Makgetla & Patel, 2021). The affected communities include the residents of mining towns that are impacted indirectly such as partners and families of workers as well as informal and informal businesses (e.g., food accommodation, and other retail services that provide goods and services to workers, managers, and their families) (Makgetla et al., 2019).

Furthermore, based on a host of indicators including, level of employment, education, access to safe water and overall quality of public hospitals and clinics were adopted to assess the sensitivity and

adaptability of Municipalities to climate change (Stats SA, 2015, 2018). It is evident that these Municipalities are in a significantly vulnerable condition. The indicators were normalized from 1-10 to give an indication of the relative importance of each indicator across the municipalities, with 1 indicating the lowest relative contribution and 10 indicating the highest relative contribution to vulnerability (see Table 2). The indicators were also color-coded, with red indicating the intensity.

In the medium to long term, foreign policy risks in a form of reduced importation of SA's coal production, reduced investors' appetite to invest in coal related activities and the global pressure to move away from coal will have a high impact on coal value chain (Makgetla et al., 2019). Similarly, domestic market and policy risks in a form of reduced demand for coal-based electricity through demand efficiency and adoption of low carbon intensive power generation technologies are also expected to have a high impact on coal value chain. The impacted role players in coal value chain include coal mining, Eskom, Transnet Freight Rail (TFR), coal transporters, small businesses, Richards Bay Coal Terminal (RBCT) and Sasol (Makgetla et al., 2019). Furthermore, to minimise the potential risks, businesses over time will have to write off coal reserves and capital investments and resulting job losses will occur. Therefore, diversifying Mpumalanga region into new economic activities is critically important (Makgetla, 2021).

MCDA framework development

As mentioned above, the MCDA method was selected for analysis of repurposing options. The development of the MCDA framework followed three steps:

1. The development of selection criteria within the dimensions of just transition,
2. Weight allocation for each criterion based on relative importance and prioritisation and
3. Development of a platform and method for the analysis and conclusion of the proposed solutions.

Significant details about the development of the MCDA framework are provided in the sections below.

Criteria development and associated weighting

The MCDA criteria used to assess the shortlisted solutions was developed through literature reviews

Table 2: Relative importance of indicators and vulnerability aspects across different municipalities in Mpumalanga province

Type of indicator	Vulnerability aspect	Msugaliikwa	Govan Mbeki	Emalahleni	Steve Tshwete
Employment	Unemployed	7.2	6.4	6.3	5.9
Education	No education	6.1	3.9	2.8	3.3
Distance to main drinking water	Hh >500 m	6.4	3.9	1.8	2.1
Access to safe water supply	Hh with no access	3.6	1.4	10.0	4.1
Mun water interruption - past 3 months	Hh with interruptions	5.9	5.0	7.0	3.1
Length of water interruption	Hh with >14 d in total	4.2	0.5	2.9	0.1
Alternative water source during interruptions	Hh using stagnant water /none	3.3	3.4	1.6	2.8
Main dwelling currently living in	Hh in informal dwellings	3.9	8.9	9.0	6.0
Overall quality of the local public hospital	Hh with no access	10.0	2.2	3.5	4.8
Overall quality of the local public hospital	Hh that do not use	4.2	5.8	5.3	7.7
Overall quality of the local public clinic	Hh with no access	7.8	2.8	5.5	3.1
Overall quality of the local public clinic	Hh that do not use	3.9	6.4	5.3	7.6
Refrigerator/ Freezer	Hh without fridge/freezer	7.9	3.7	9.8	4.6
Motor vehicle	Hh without motor vehicle	8.7	7.7	8.0	6.8
Radio	Hh without radio	5.9	6.0	8.1	6.2
TV	Hh without TV	6.7	3.4	10.0	3.9
Landline	Hh without landline	9.6	9.3	9.6	9.5
Cell phone	Hh without cell phone	6.8	4.8	6.9	4.0
Aircon	Hh without aircon	9.5	9.1	9.6	9.6
Run out of money to buy food in past 12 months	Hh no money for food	4.8	4.4	4.5	6.5
Run out of money to buy food for 5 or more days in past 30 days	Hh running out of food	7.6	7.3	7.9	7.0
Skipped meal in past 12 months	Hh skipping meals	4.4	4.7	4.5	7.1
Skipping meal for 5 or more days in the past 30d	Hh skipping meals	7.7	7.4	7.5	7.4

and stakeholder engagements with representatives from the Department of Mineral Resources and Energy (DMRE), Department of Forestry, Fisheries and Environment (DFFE), National Treasury, SASOL, South African Photovoltaic Industry Association (SAPVIA), Congress of South African Trade Unions (COSATU), ESKOM, the Mineral Council South Africa, and CSIR.

The criteria were categorised into 6 segments i.e., economic, environmental, technical, project feasibility, social and other. The final set of criteria was consolidated to include assessable criteria.

To determine the weights for each criterion, stakeholders ranked each criterion and once the rankings were received from the stakeholders, these

were converted into average weights using the equation defined in section 4.2 below. The last step was to normalise the weights to 100% (Alfares & Duffuaa, 2008). Various stakeholders provided inputs in this regard, some of the main stakeholders included ESKOM, COSATU, SASOL, Sam Tambani Research Institute (SATRI)/ National Union of Mineworkers (NUM), Coal Tech, CSIR, Indalo, Earth life, SAPVIA, DMRE, DFFE, South African Wind Energy Association (SAWEA) and the IPP Office (IPPO).

Formula used to derive criteria weights

To develop aggregated criteria weights, an empirical rank-weight relationship was used (Hesham & Duffuaa, 2008). This linear relation specifies the average weight for each rank of an individual criterion. Furthermore, the linear relation assumes that the aggregated weight of all the criteria ranks is 100%. For any set of ranked criteria, the percentage weight of criteria ranked r is given by the equation/s below:

$$\omega_{r,n} = 100 - s_n(r - 1),$$

$$\text{Where } s_n = 3.195 + \frac{37.758}{n}, 1 \leq n \leq 21, 1 \leq r \leq n, r \text{ n and r are integers}$$

There is an upper limit of 21 i.e., total maximum number of criteria. The aggregation data is criterion specific, therefore the criteria for coal power stations and coal mines cannot be combined. There were 21 and 18 criteria identified for coal power stations and coal mines, respectively.

The method however does have the following limitations (Hesham & Duffuaa, 2008):

- The methodology cannot recognise the different intensities of preference among individual decision makers, thereby giving equal weight to each individual criterion that is ranked and
- The approach to collect the data (rankings) is not a decision-making process. The presence of concrete decision alternatives might therefore influence individual criteria ranks.

Furthermore, to determine performance scores or ranking, experts' inputs were again solicited to assist in scoring the shortlisted solutions against each criterion using discrete scoring range values (see results in

section 5.2). The scoring ranges were developed by experts and were 0-1, where 0 is least favourable and 1 favourable.

MCDA for solutions

The final step was to multiply the weighting by the scores received from various technical experts to obtain the overall score and ranking of solutions. Surveys containing the description of the projects and the scoring ranges for each criterion was sent out to these. The stakeholders had to score each solution based on their experience, expertise, and knowledge. The list of solutions and associated criteria was quite extensive, therefore different stakeholders assessed different sets of projects. Each stakeholder was required to score 4 different projects.

Results and discussion

Criteria development

This section provides the consolidated set of criteria

that was developed for the MCDA application. Figure 3 and Figure 4 show the set of criteria which was used to assess the repurposing solutions for coal power stations and coal mines, respectively.

Criteria weighting and scoring range

This section provides the results obtained for the final criteria weighting and scoring ranges for each criterion. Table 3 and Table 4 detail this information for coal power stations and coal mines, respectively.

It is evident that, for coal power stations, significant priority was assigned to technical feasibility (7.04%) followed by access to funding (6.77%), reduction of GHG emissions (6.46%) and job creation (6.44%). While for coal mines, significant prioritization was access to funding (7.73%) followed by financial sustainability (7.35%) and job creation (7.23%).

Coal power stations repurposing solutions

Experts from group 1 assessed the following set of solutions: Conversion to data center, mixed used

TECHNICAL

- Technical feasibility (LCOE, etc.)

ECONOMIC

- Financial sustainability
- Access to funding
- Economic diversification
- Labour - job creation/increase in income for the local community
- Reskilling & skills requirements (need for specialist workforce) & skills

ENVIRONMENTAL

- Reduction of GHG emissions
- Water usage and conservation
- Rehabilitation of land (and required funding)

SOCIAL

- Diversity aspects (gender, racial, equality, disability, etc)
- Positive changes in livelihood (community development)
- Improved health impacts

PROJECT FEASIBILITY

- Ease of implementation
- Timeline to implement the project
- Locality of the project
- Investment mandate (key for donors)

OTHER CRITERIA

- Solution meeting Just Transition mandate

Figure 3: Criteria developed for repurposing of coal power stations

ENVIRONMENTAL

- Water usage and conservation - acid mine drainage impacts
- Rehabilitation of land (and required funding) and current land use in surrounding areas
- Effects on biodiversity (climate regional flora and fauna)

TECHNICAL

- Re-use potential of mine facility
- Required machines and equipment availability
- Reskilling requirements (need for specialist workforce) & skills development
- Replicability/modularity/transferability

ECONOMIC

- Access to funding
- Financial sustainability
- Labour - job creation/increase in income of local community
- Export earning impact/potential

SOCIAL

- Diversity aspects (gender, racial, equality, disability, etc)
- Positive changes in livelihood quality (community development)
- Tourist attraction
- Mining company policy

PROJECT FEASIBILITY

- Ease of implementation (i.e., the less complex the better)
- Timeline to implement the project (i.e., shorter is better)
- Locality of the project
- Investment mandate (key for donors)

OTHER CRITERIA

- Does the project meet JET mandate

Figure 4: Criteria developed for repurposing of coal mines

Criteria and description	Dimension	Weighted (W)	Scoring Range (SR)
Access to funding	Economic	6.77%	- 0.5: Difficulty in obtaining funding - 1: Funding is easily available
Financial Sustainability	Economic	6.08%	- 0: Market anticipated but still nonexistent, Return on Investment (ROI) >8 years and Net Present Value (NPV) not certain - 0.5: Market still developing, ROI in 4-7 years and positive NPV - 1: Market-ready, ROI within 3 years and high NPV
Economic diversification	Economic	4.15%	- 0: No diversification from coal - 0.25: New fossil-fuel energy applications with lower emissions - 0.5: New industry which still relies on coal, e.g., steelmaking - 0.75: New sustainable non-energy markets created e.g., agriculture, tourism - 1: New sustainable markets/New sectors in "clean" energy - e.g., solar, wind, green hydrogen
Labor - job creation/ increase in income for local community	Economic/Social	6.44%	- 0: Little to no job absorption (0-20%) - 0.25: Some jobs absorbed i.e., new employees (21% - 49%) - 0.5: Significant number of jobs absorbed (50% - 79%) - 1: Majority to all jobs absorbed (80% 100%)
Reduction of GHG emissions	Environmental	6.46%	- 0: Little to no reduction in emissions (<10%) - 0.3: Minimal to low reduction in emissions (10% - 39%) - 0.6: Significant reduction in emissions (40% - 79%) - 1: Near total reduction in emissions (80% - 100%)
Water usage & conservation	Environmental	4.77%	- 0: Unsustainable use of water - 0.5: Minimal reduction in water usage - 1: Sustainable use of water
Rehabilitation of land (and required funding)	Environmental	4.11%	- 0.25: Total rehabilitation of land required - 0.5: Partial rehabilitation of land required - 1: No rehabilitation required
Generation plant supplying power into the grid	Technical	4.64%	- 0: Does not add generation capacity to the grid and no grid support - 0.5: Not adding generation capacity to the grid but assisting with grid support - 1: Adds generation capacity to the grid and assists with grid support
Technical feasibility	Technical	7.04%	- 0.25: Promising technology but not proven beyond the small scale (TRL <4) - 0.5: Technology currently at demonstration stage (TRL 5-7) - 1: Commercially available and proven technologies (TRL 9)
Use of existing infrastructure in the power station	Technical	4.26%	- 0.25: Minimal use of existing infrastructure - 0.5: Some use of existing infrastructure - 1: Maximum use of existing infrastructure

Table 3: Criteria weighting and scoring ranges for coal power station repurposing solutions

Use of existing infrastructure to integrate power	Technical	3.57%	- 0.25: Minimal use of existing infrastructure - 0.5: Some use of existing infrastructure - 1: Maximum use of existing infrastructure
Required machines and equipment availability	Technical	2.55%	- 0: <10% of the equipment is available locally - 0.25: 11% - 30% of the equipment is available locally - 0.5: 31% - 60% of the equipment is available locally - 0.75: 61% - 80% of the equipment is sourced locally - 1: 81% - 100% of the equipment is locally sourced
Reskilling requirements (Need for specialist workforce) & skills development	Technical	4.82%	- 0.25: High reskilling requirements - 0.5: Moderate reskilling requirements - 1: Minimal reskilling requirements
Replicability/modularity/transferability	Technical	2.50%	- 0.1: Very difficult - 0.5: Moderately difficult - 1: Easy
Diversity Aspects (Gender, racial equality, disability etc.)	Social	3.44%	- 0: Will result in less inclusivity - 0.3: Will not change status quo - 0.6: May result in more inclusivity - 1: Will result in more inclusivity
Positive changes in livelihood quality (community development)	Social	5.48%	- 0.25: Minimal improvement in livelihood quality - 0.5: Moderate improvement in livelihood quality - 1: Significant improvement in livelihood quality
Improved health	Social	4.46%	- 0.25: No improvement in the quality of health - 0.5: Minimal improvement in the quality of health - 1: Significant improvement in the quality of health (linked to reduction in GHG emissions)
Ease of implementation and timeline to implement the project	Project feasibility	5.04%	- 0.25: Difficult to implement/ execute - 0.5: Manageable (can be executed with support) - 1: Easily implementable
Locality of the project	Project feasibility	4.13%	- 0.25: Minimal use of local resources - 0.5: Some use of local resources - 1: Make use of local resources
Investment within government mandate	Project feasibility	3.84%	- 0: No government support - 0.5: Possibility of public and private partnership - 1: Full government support with policies in place
JET Mandate	Other	5.26%	- 0.5: Meet some aspects of the JET mandate - 1: Meet JET mandate
Total		100%	

Criteria and description	Dimension	Weighted (W)	Scoring Range (SR)
Access to funding	Economic	7.73%	- 0.5: Difficulty in getting funding - 1: Funding is easily available
Financial Sustainability	Economic	7.35%	- 0: Market anticipated but still nonexistent, Return on Investment (ROI) >8 years and Net Present Value (NPV) not certain - 0.5: Market still developing, ROI in 4-7 years and positive NPV - 1: Market-ready, ROI within 3 years and high NPV
Export earning potential	Economic	4.50%	- 0: No potential to earn any income - 0.25: Target market mostly local - 0.75: Target market mostly international - 1: Target market exclusively international
Labor - job creation/ increase in income for local community	Economic/Social	7.23%	- 0: Little to no job absorption (0-20%) - 0.25: Some jobs absorbed i.e., new employees (21% - 49%) - 0.5: Significant number of jobs absorbed (50% - 79%) - 1: Majority to all jobs absorbed (80% - 100%)
Effects on biodiversity (Climate Regional flora and fauna)	Environmental	6.17%	- 0: Little to no reduction in emissions (<10%) - 0.3: Minimal to low reduction in emissions (10% - 39%) - 0.6: Significant reduction in emissions (40% - 79%) - 1: Near total reduction in emissions (80% - 100%)
Water usage & conservation- acid mine drainage impacts	Environmental	5.94%	- 0: Unsustainable use of water - 0.5: Minimal reduction in water usage - 1: Sustainable use of water
Rehabilitation of land (and required funding)	Environmental	6.12%	- 0.25: Total rehabilitation of land required - 0.5: Partial rehabilitation of land required - 1: No rehabilitation required
Re-use potential of mine facility	Technical	5.26%	- 0.25: Minimal use of existing infrastructure - 0.5: Some use of existing infrastructure - 1: Maximum use of existing infrastructure
Required machines and equipment availability	Technical	4.70%	- 0: 10% or less of the equipment is available locally - 0.25: 11% - 30% of the equipment is available locally - 0.5: 31% - 60% of the equipment is available locally - 0.75: 61% - 80% of the equipment is sourced locally - 1: 81% - 100% of the equipment is locally sourced
Reskilling requirements (Need for specialist workforce) & skills development	Technical	5.59%	- 0.25: High reskilling requirements - 0.5: Moderate reskilling requirements - 1: Minimal reskilling requirements
Replicability/modularity/transferability	Technical	3.26%	- 0.1: Very difficult - 0.5: Moderately difficult - 1: Easy

Table 4: Criteria weighting and scoring ranges for coal mines

Diversity Aspects (Gender, racial equality, disability etc.)	Social	5.06%	- 0: Will result in less inclusivity - 0.3: Will not change status quo - 0.6: May result in more inclusivity - 1: Will result in more inclusivity
Positive changes in livelihood quality (community development)	Social	6.73%	- 0.25: Minimal improvement in livelihood quality - 0.5: Moderate improvement in livelihood quality - 1: Significant improvement in livelihood quality
Tourist attraction	Social	2.68%	- 0: No tourist attraction - 0.5: Predominantly local - 0.75: Predominantly international - 1: Tourist attraction (local and international)
Ease of implementation and Timeline to implement the project	Project feasibility	5.29%	- 0.25: Difficult to implement/ execute - 0.5: Manageable (can be executed with support) - 1: Easily implementable
Locality of the project	Project feasibility	6.09%	- 0.25: Minimal use of local resources - 0.5: Some use of local resources - 1: Make use of local resources
Mining Company policy	Social	4.76%	- 0.25: No policy for post mining rehabilitation - 0.5: Moderate policy requirements - 1: Mandated existing clear policies for rehabilitation
JET Mandate	Other	5.53%	- 0.5: Meet some aspects of the JET mandate - 1: Meet JET mandate
Total		100%	

development, data center and industrial park as illustrated in Figure 5. From the responses from stakeholders and subsequent analysis for this set of solutions, conversion to learning and development center scored the highest (0.68), followed by mixed used development (0.59) and data center (0.56) and lastly industrial park.

Experts from group 2 assessed the following set of solutions: conversion to natural gas power plant, conversion to renewable energy cluster, conversion to battery storage facility, ash greening cement and the development of green hydrogen hub as illustrated in Figure 6. From the responses from stakeholders and subsequent analysis for this set of solutions, conversion to renewable energy cluster scored the highest (0.66), followed by conversion to biomass power generation (0.60) and natural gas power plant (0.51) the green hydrogen hub (0.49).

Experts from group 3 assessed the following set of solutions: conversion to battery storage facility, RE manufacturing hub, agrivoltaic development and ash greening cement as illustrated in Figure 7. From the responses from stakeholders and

subsequent analysis for this set of solutions, agrivoltaic development scored the highest (0.65), followed by conversion to battery storage facility (0.64) and ash greening cement (0.62) then RE manufacturing hub (0.57).

Overall, the top 6 scoring solutions across all groups were conversion to learning and development center, conversion to renewable energy cluster, agrivoltaic development, conversion to battery storage facility, ash greening cement and conversion to biomass power generation.

Coal mine repurposing solutions

Experts from group 1 assessed mixed development, pumped storage hydro, conversion to hotel powered by RE and conversion to data center solutions as illustrated in Figure 8. From the responses from stakeholders and subsequent analysis for this set of solutions, conversion to hotel powered by RE scored the highest (0.63), followed by conversion to pumped storage hydro (0.56) and mixed development (0.53) then conversion to data centre (0.49).

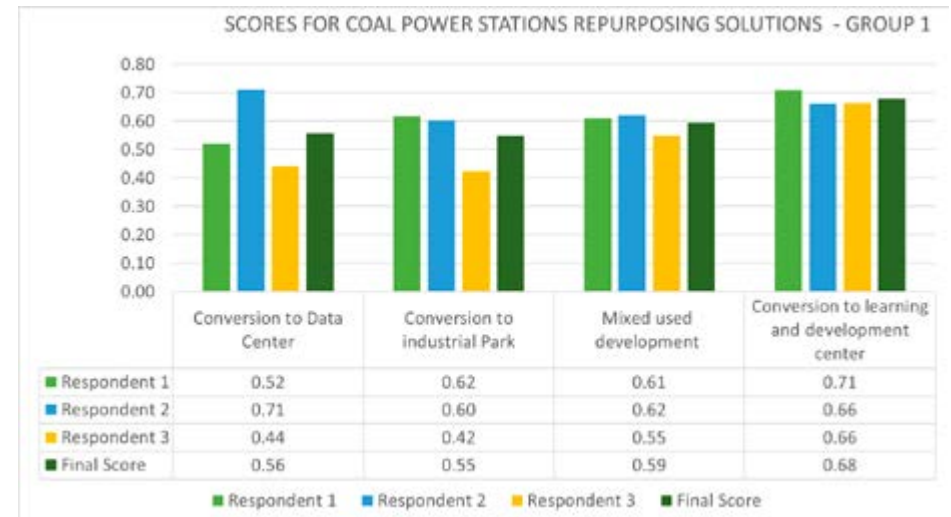


Figure 5: Overall scores for repurposing solutions for coal power stations – Group 1

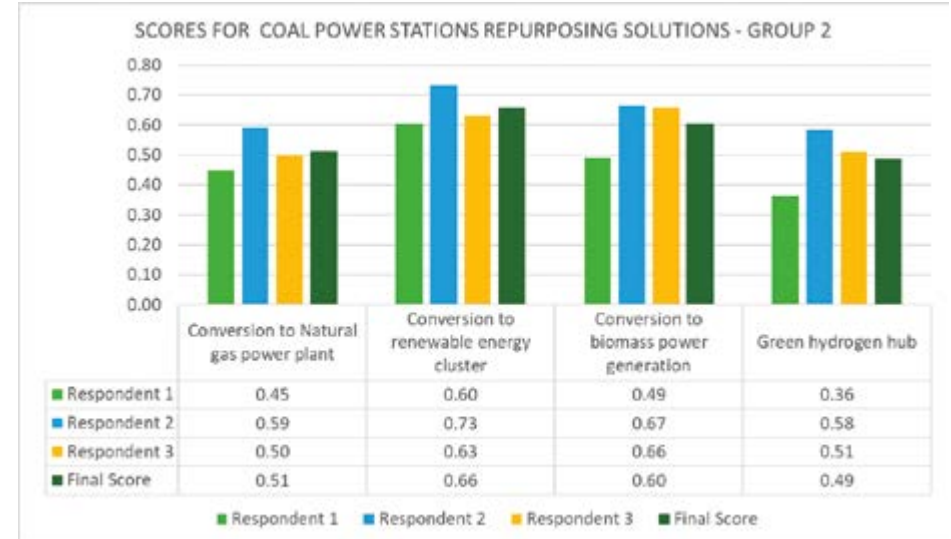


Figure 6: Overall scores of repurposing solutions for coal power stations - Group 2

Experts from group 2 assessed solar PV plant, wind farm facility, solar CSP, ecotourism park and science/art/cultural park solutions as illustrated in Figure 9. From the responses from stakeholders and subsequent analysis for this set of solutions, ecotourism park scored the highest (0.64), followed by conversion to a solar PV plant (0.60), wind farm development and

science/art/culture parks having the same score of 0.59 and then solar CSP development (0.52).

Overall, the top 6 scoring solutions across all groups were conversion to ecotourism park, hotel powered by RE, conversion to solar PV plant, wind farm development and development of science/art/culture parks.

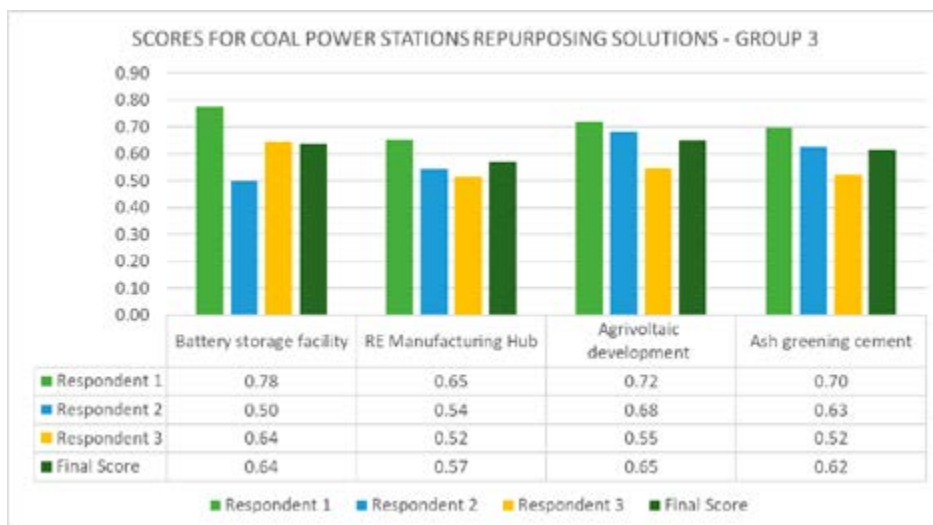


Figure 7: Overall scores for repurposing solutions for coal power stations - Group 3

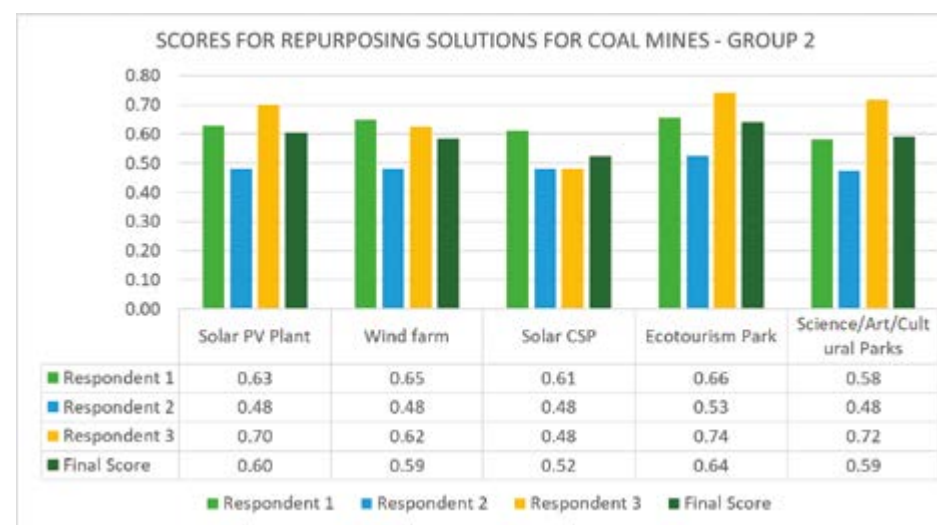


Figure 9: Overall scores of repurposing solutions for coal mines - Group 2

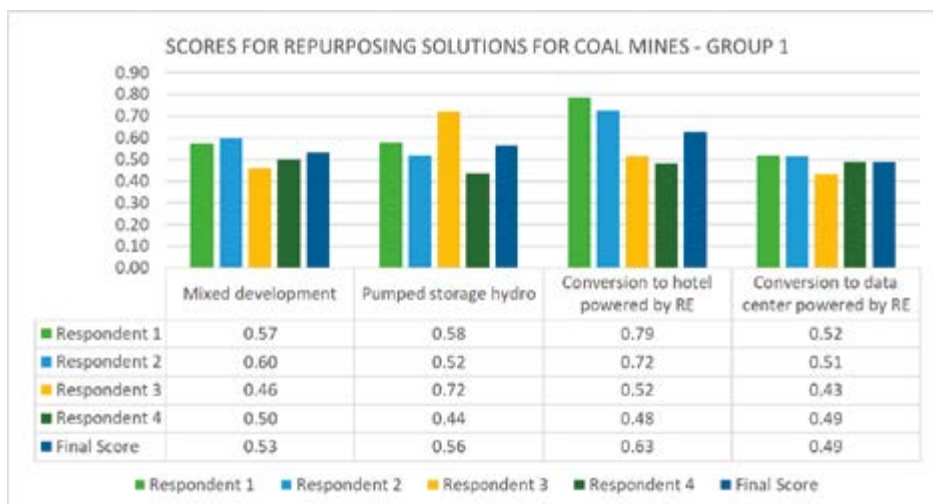


Figure 8: Overall scores for repurposing solutions for coal mines – Group 1

Conclusion

This article provided insight into the dimensions that should be considered when evaluating repurposing options for coal mines and coal power stations for a “just” transition. Technical, environmental, economic, and social imperatives must be considered, and these must be prioritized

to incorporate social justice at the level and context of the project. The literature review details some findings from projects that have been or are currently being implemented internationally. The review also identified sector linkages between coal and other sectors in the coal value chain. It is well noted that Mpumalanga will be significantly

impacted as the predominant portion (>80%) of the coal value chain activities are housed in this province.

This research project used findings from the literature review and stakeholder inputs for the development of a multi-criteria decision analysis (MCDA) framework for coal power stations and coal mines. The implementation of the MCDA concluded that the top three solutions for coal power stations were conversion to learning and development center, conversion to renewable energy cluster and agrivoltaic development; and for coal mines conversion to ecotourism park, hotel powered by renewables and conversion to solar PV plant.

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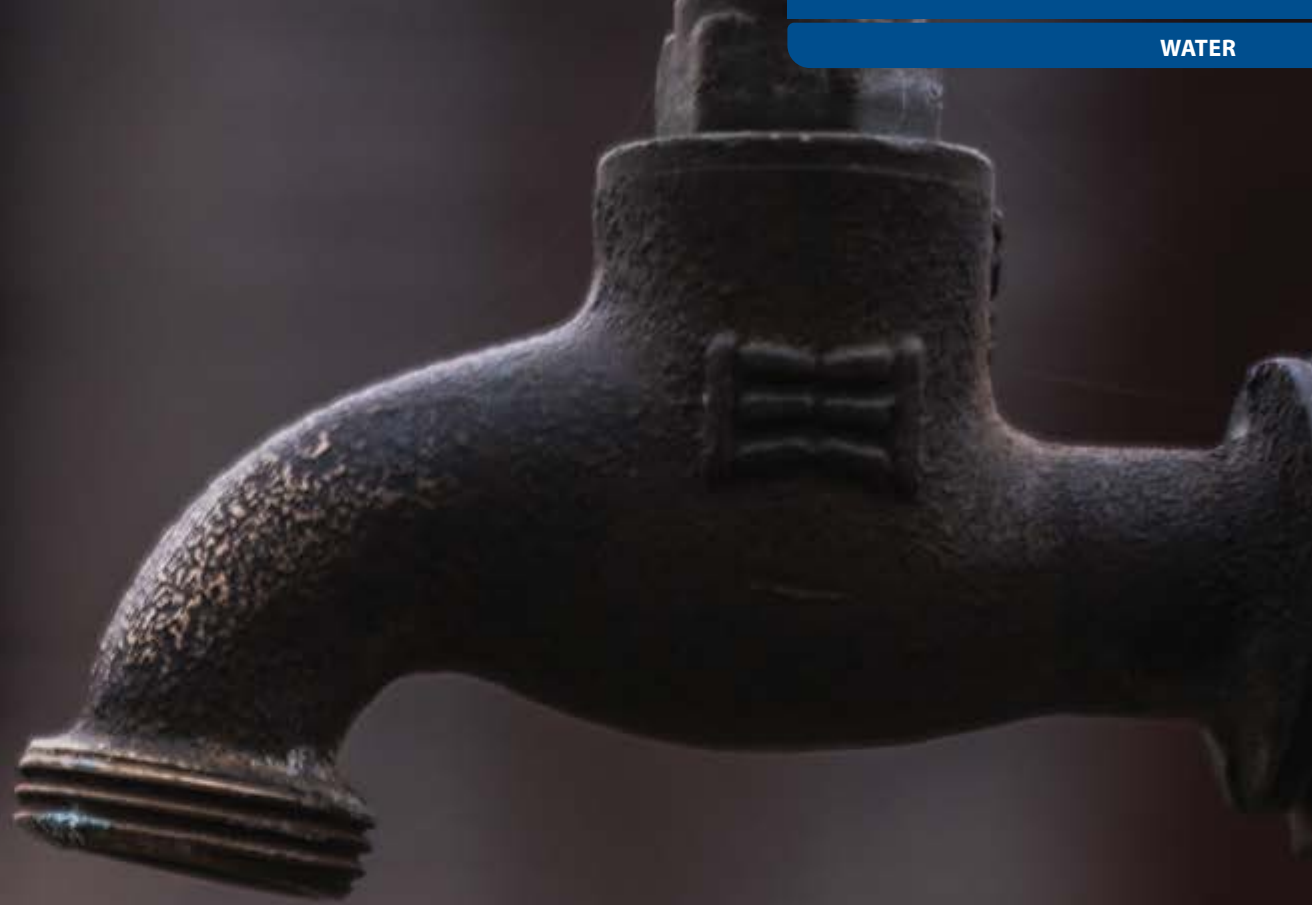


WATER



Water status in South Africa-an opinion from the SA Water Chamber CEO

Benoît Le Roy



South Africa has seen 2022 the year of water shedding, a term not easily accepted by officials but a stark reality as many basic services that have collapsed over the past decade outside the metros now start to collapse in the metros. The Nelson Mandela Bay Metro had to resort to water shedding this year to stave off a very real threat of Day Zero due to a decade of inaction on its water resource diversification program that was supposed to have been initiated a decade or more ago. Gauteng metros ran out of water this October despite the IVRS, Integrated Vaal River System, being over 90% full.

Both these examples have some 40% NRW, Non-Revenue Water, with 90% of it physical leaks mostly in their bulk mains supplying the water distribution systems. Irrespective of water resources, the distribution systems of bulk water to consumers cannot operate optimally and definitely not when under strain with 40% NRW.

So, NMBM could have largely avoided the panic induced in the economy and society had it not suffered from the "leaking bucket" syndrome, losing around 100MGLD of its 250MGLD average demand. The city of Joburg has similar losses that coupled with hot weather, load shedding and insufficient reservoir

storage capacity ran out of water and allowed the distribution system to run dry which it's not designed to do. The dry system when recharged with water suffers inordinate pressure spikes and when it's old and leaky like in Joburg, it causes an exponential increase in burst pipes further losing water in the system causing long delays, so water shedding.

The reality is that in South Africa we have not managed our water assets diligently and have sweat them past their useful lives. The highest value asset in any metro is its water system with COJ reporting that theirs is around R120 billion in 2022. This infers that the majority of a city budget must be allocated to manage their water assets, a new paradigm we have to urgently adapt or suffer a total collapse of water systems and then the economy. The water shedding phenomenon is actually a symptom of failed economics and as such the root causes have to be addressed to return to a modicum of water security.

A healthy economy is required to maintain a reasonable level of water security and we know full well how depressed the SA economy is, so whilst water security and economic health are interwoven,

we have to find ways to rekindle both. The South African Water Chamber, SAWC, was established to enhance the collaboration of the public and private sector in all things water, especially infrastructure. We have contributed to many policies from the NDP's national water security framework to the NIP 250, National Infrastructure Plan, but still lack the implementation of the master plans in reality as most of the action in infrastructure is at a local government level, the one with the least capabilities at this stage.

The priorities as espoused in the master plans are NRW, Reuse and New Water via Desalination where only some traction has started in the city of Cape Town. So, national government has collaborated with all three spheres of government, NGO's and the private sector in developing the master plans but that's where it stops unfortunately when one looks at implemented programs. Clearly SA is not master plan deficient, and it is also not technology deficient, it is implementation hamstrung.

Parking the unhealthy economy for a while as its outside of our direct remit in the water sector, what



else can we do to get the traction in implementing the master plans? There are three key certainty issues:

1. Policy
2. Regulatory
3. Contracting

We have reasonable policy certainly reflected in the numerous master plans and strategies gazetted over the past few years. How effective they are needs to be tested. Regulatory reform is taking place with DWS establishing an Independent Water Regulator, IWR, after major lobbying by the SA Water Chamber in conjunction with other NPO's. Most sectors in SA are well regulated but the water sector slipped through the cracks for the past few decades, without modern independent regulation the private sector will simply not invest and we would not be in this crisis. The last and more complicated issue is the contracting certainty that is fairly well developed in the bulk infrastructure sector through the larger water boards and TCTA and the recently just about established National Water Infrastructure Agency that is out for public comment via a recent gazette. The fact that most of the required action is at local government that is the least bankable, capacitated and unable to contract sustainably, is where our efforts need to be directed.

So, what can the private sector do as the funding shortfalls from the fiscus necessitate the participation private sector as recognised by all of the master plans? These are the high-level contracting issues in our opinion:

- The DBSA, Development Bank of Southern Africa, has established the Water Partnership Office in conjunction with the Department of Water and Sanitation, DWS, to assist in catalysing projects programmatically through funding project preparation as generically as possible so as to enable a rapid, consistent and effective roll out of projects using standardised approaches.
- Implement blended finance solutions where DFI's and government can seed project funding and de-risk to an extent required to attract the required private sector funding to fill the funding deficits.
- Large private sector industry that uses potable water from municipalities and water boards need

to change over to reuse quality water fit for purpose that is not only generally cheaper but more secure in supply.

- A new risk appetite needs to be explored for PPP's, Public Private Partnerships, that are traditionally secured by Sovereign Guarantees no longer available in SA for obvious reason.
- Implement the digitisation of the water value chain as part of the toolbox to render water programs bankable.

Whilst we have seen major coverage of water and sanitation problems in the media, the gravity of our situation does not seem to have sunk in yet. The disastrous sewage pollution in Ethekwinini may well demonstrate the crisis this festive season as tourists stay away from polluted beaches, sidewalks and rivers. The consequences are dire indeed and we have to take action on all master plans to implement the required water and sanitation security a healthy society and economy requires.



Benoît Le Roy

Lepelle Northern Water making strides within its sphere of operation

The recent appointment of Lepelle Northern Water's (LNW) new Chief Executive Officer (CEO) has not only set the bulk water supplier off on a new trajectory but resulted in the organisation having made significant strides in the sphere within which it operates.

The most recent achievement is the signing of a 10-year bulk water supply Service Level Agreement (SLA) concluded with Vhembe District Municipality in Limpopo during a ceremony on 21 October 2022.

Dr Cornelius Ruiters assumed the position of LNW's CEO on 1 July 2022 and from the onset has tackled operational and organisational challenges head-on with the support of the LNW Board, Executive Committee (EXCO) and workforce.

CEO's vision for LNW to claim place among SA's top three

His vision for providing excellent quality services to customers and communities within LNW's area of operation across Limpopo underscores the organisational values and is projected to assist in catapulting the organisation to claim its place among the three most progressive water boards in the country.

Dr Ruiters boasts extensive experience, knowledge and expertise in the engineering and science fields

and holds degrees in Science and Engineering and Business Administration from the Universities of the Western Cape, Witwatersrand, Pretoria and South Africa respectively. He has completed PhD studies and research through San Diego State University in California.

He is a registered Professional Natural Scientist and Civil Engineer who has been actively working in the academic, private and public sectors. Dr Ruiters has extensive experience in environment and water resources and supply services engineering and management. His vocational work experience includes water resources infrastructure, water supply management, water distribution infrastructure and operations and maintenance, water and wastewater treatment as well as solid waste management. In



Dr Cornelius Ruiters

addition, he has a strong background in integrated environmental management and sustainable development. He further boasts an extensive record of approximately 300 citations and more than 50 publications in the fields of science and engineering.

Providing bulk water to WSAs, mines, industries in Limpopo

Through its operations LNW provides water to an estimated three million people in the province, across a surface area of an approximate 80 000 square kilometres. LNW, with a staff complement of an estimated 400 employees, operates within the three regions of Capricorn, Sekhukhune and Mopani.

Apart from the latest addition of Vhembe District Municipality to the list of bulk customers with whom SLAs have been entered into LNW provides bulk water volumes to five more Water Services Authorities (WSAs), being Polokwane Local Municipality, Capricorn District Municipality, Sekhukhune District Municipality, Mopani District Municipality and Mogalakwena Local Municipality.

It simultaneously provides potable water to end users and water for use by mining operations and industries across Limpopo, performs water conservation functions and makes available chemical and microbiological analysis services through its laboratory that is accredited with the South African National Accreditation System (Sanas) and located at Ebenezer Scheme. By applying the most technologically advanced laboratory equipment, its scope of analyses includes potable, borehole, river and effluent water.

Apart from management and support activities to WSAs, LNW further acts as implementing agent for the Department of Water and Sanitation. The intended upgrade of the Ebenezer and Olifantspoort Schemes, which provide the City of Polokwane with water, counts among the biggest projects managed to date. The cost of the project is currently projected at R18 billion.

Taking care of the environment

Through its contribution towards sustainability, LNW is committed to taking care of the environment. In terms of its ISO 14001 2015 certification, LNW identifies, manages, controls and monitors environmental issues in a holistic manner.



LNW ensures decreasing its environmental footprint by monitoring current weather conditions, increasing the capacity of wastewater treatment works and stormwater collection, modelling and monitoring of groundwater for informed aquifer management and reducing its carbon footprint through minimised energy use, timely replacement of parts and monitoring chemical use.

Recycling systems aimed at conserving water have been installed at the Olifantspoort and Flag Boshielo Schemes.

Endeavouring to continuously change lives

The organisation upholds the values underpinned by the Batho Pele principles in the management of its operations and the manner in which it conducts business. The core values guiding operations are excellence, integrity, loyalty, team spirit, respect and innovation.

"Water Is Our Passion" underscores the LNW identity and this insignia matches the corporate logo reflected in a water drop and waves in three colours blue on white.

Through its mandate and reach the organisation continues to endeavour to change lives within its area of operation. LNW remains committed to extending a hand of goodwill where assistance is required and sustains its efforts in a myriad of ways by joining hands with external stakeholders through outreach projects and initiatives targeting needy causes.



WASTE



Beyond recycling – a climate-adapted business landscape

Catherine Wijnberg, CEO, Fetola

A circular business presents opportunities for entrepreneurs and ESG impact investors

It is clear that we need to jump ship. It no longer makes sense to sit by the sidelines hoping that global leaders will act on targets to reduce greenhouse gas (GHG) emissions and deliver us a low-carbon future.

By giving up on the 1.5C goal, the COP 27 leaders have effectively handed the baton of responsibility to the wider global community of citizens, businesses and impact investors.

The need is great. Taking the example of South Africa, which is recorded as the 30th driest country in the world¹ and warming at twice the global average², the country faces an uncertain future. Climate change is creating huge disruption and uncertainty to that

water cycle³, which means that we cannot continue with the same disregard for those resources through over extraction and pollution⁴.

Water stress will displace up to 700 million people in Africa by 2030, and with South Africa the most populated nation south of the equator⁵,



how will the inevitable migration trends impact the country?

Water is critical. It is required at all stages of food production, with agriculture accounting for 70% of the water used throughout the world⁶. Alongside this, food productivity is being significantly impacted by climate change and has already decreased by 21%⁷. Yet despite this, high amounts of food are discarded throughout the supply chain at rates that are unsustainable.⁸

Wherever there is a problem there is a business opportunity. There is increasing evidence of effective solutions which design out waste and can transition our world to a new, circular, low carbon economy. Circularity also addresses the other critical societal factors in the South African landscape, namely unemployment and poverty, making these solutions of special interest for Government, corporates and ESG investors alike.

In addition, roughly 122 million tonnes of waste are produced by South Africans each year. Of this, only an estimated 10% is recycled or recovered for other use, with 90% being thrown away. Yet, by designing out waste through the creation of a continuous lifecycle of material use and reuse, we change the narrative from one of waste being worthless to a huge business opportunity. The circularity model achieves this by rethinking existing models which generate waste and introducing concepts such as rental, repair and life extension which make business and environmental sense.

The cooperative Southern Basadi, led by Delores Mackenzie, is one such company who has redesigned thinking around waste. In a collaboration with Netcare Adcock Ingrams, they take used IV bags, an item previously considered worthless, and turn them into durable, waterproof and cost-effective school shoes. Once the learners have outgrown the shoes, these can be returned to the factory, re-crumbled and re-made into new

shoes ensuring that the reclaimed plastic never has to end up in landfill.

Farming is a huge contributor to the climate change challenge yet there are immediate solutions that can be adopted to mitigate this. One solution is regenerative agriculture with its holistic concept that treats the soil and the network of fungal mycorrhizae as integral to the food production process. In this system inputs of synthetic nitrogen-based fertilizers, a major source of GHG emissions (their use having increased an alarming 800% in the last six decades), can be replaced by organic fertilizers that are more cost-effective, replenish the land and capture carbon in the soil.

A collaborative effort between municipalities, who were battling with a toxic mountain of sewage sludge, and an innovative agri-preneur who saw value in this waste, has resulted in a profitable business with multiple benefits. Whilst Agriman processes a small portion of the 700,000 tonnes of sewerage sludge that otherwise goes to SA landfills each year, their efforts limit GHG emissions, benefit regenerative agriculture, increase employment, and are replicable.

A key component of circularity is product life extension. Dilex, is one such small business that extends the life of engine oil – collecting and cleaning 600,000 kilolitres of used car oil and selling it back to users. By eliminating oil waste, they save 500 billion litres of water annually from contamination. This South African company has successfully shifted a typical cradle-to-grave (take, make, waste) business model into a cradle-to-cradle model where the oil is seen as an eternal resource, eliminating wasteful practices harmful to future generations. The cleaned oil is cheaper than crude and can be repurposed again and again, resulting in both cost savings and a lower environmental impact.

The time has long passed for citizens to simply accept wasteful, polluting business models. Circularity is a logical concept that can be incorporated either by

tweaking elements of the production chain, or through full immersion into a low-carbon, high sustainability, circular model. These practices often result in improved profitability, alongside environmental and social benefits.

Sustainability is gaining acceptance across the world, yet in South Africa there is still resistance towards uptake. Two of the arguments against it being that it is either an expensive luxury or an unnecessary distraction. This points firstly to a lack of awareness of circular models that are profitable and marketable. It also highlights the lack of access to finance in this sector, with only 3%⁹ of green funds invested in Africa.

The second issue indicates a lack of understanding regarding the relevance of sustainability. This highlights a need for circularity ambassadors to be profiled in communities and in mainstream media as influencers and role-models. It emphasises the importance of messaging that is relatable, easy to understand and translated into local languages, with effective communication around circularity incorporated into the learning “storyboard” as early as the pre-entrepreneur stage at schools and for it to be the foundation of business school training.

One such pilot initiative in South Africa is Fetola’s 6-month programme, the Circular Economy Accelerator Boost, a template which onboarded 46 businesses, of which 11 had no circularity on commencement of the intake (4 were not even aware that circularity existed). The pillars of the accelerator were mentorship, business skills development, networking and education on circularity models. The initiative delivered positive revenue growth of 23%, illustrating that whilst the circular business model makes sense from an ecological footprint, it is also clearly a savvy economic strategy.

There is tremendous interest within the business community for programmes such as this. Yet the mechanics of multiplying this model so that there can be broad-scale uptake across the business ecosystem requires collaboration, investment, support from government municipalities and legislation that is

enabling. It presents a far brighter future and is a model that should be embedded as the norm.

About Fetola

Fetola is a leading provider of scalable, world-class entrepreneurial support programmes that deliver lasting social, environmental and economic impact.

Their goal is to grow the economy, create inclusive wealth and generate jobs by helping people build businesses that last.

This is achieved by providing proven business strategy, systems and support, while unlocking the personal leadership power of entrepreneurs who are inspired to leave a lasting legacy.

Fetola means “change” in Sesotho - and the Fetola team are inspired by UN Global goal 17 to generate change at a global scale and foster partnerships that are a force for good. For more information, visit <https://fetola.co.za/>

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AGRICULTURE & FOOD SECURITY



A digital training program in Aquaponics for the southern African development community

Henk Stander

Introduction

The Southern African Development Community (SADC) was established as a development coordinating conference (SADCC) in 1980 and transformed into a development community in 1992.

It is an inter-governmental organisation whose goal is to promote sustainable and equitable economic growth and socio-economic development through efficient productive systems, deeper co-operation and integration, good governance and durable peace and security among sixteen Southern African Member States.

The main objectives of the Southern African Development Community (SADC) are to achieve economic development, peace and security, and growth, alleviate poverty, enhance the standard and

quality of life of the peoples of Southern Africa, and support the socially disadvantaged through Regional Integration. These objectives are to be achieved through increased Regional Integration, built on democratic principles, and equitable and sustainable development.

The objectives of SADC, as stated in Article 5 of the SADC Treaty (1992) are to:

- Achieve development and economic growth, alleviate poverty, enhance the standard and quality of life of the people of Southern Africa and support the socially disadvantaged through Regional Integration;
- Evolve common political values, systems and institutions;
- Promote and defend peace and security;



- Promote self-sustaining development on the basis of collective self-reliance, and the inter-dependence of Member States;
- Achieve complementarity between national and regional strategies and programmes;
- Promote and maximise productive employment and utilisation of resources of the region;
- Achieve sustainable utilisation of natural resources and effective protection of the environment;
- Strengthen and consolidate the long-standing historical, social and cultural affinities and links among the people of the Region.

SADC countries face many social, development, economic, trade, education, health, diplomatic, defense, security and political challenges. Individual members cannot tackle some of these challenges effectively. Cattle diseases and organised-crime gangs know no boundaries. War in one country can suck in its neighbours and damage their economies.

The sustainable development that trade could bring is threatened by the existence of different product standards and tariff regimes, weak customs infrastructure and bad roads. The socio-economic and political and security cooperation aims of SADC are equally wide-ranging, and intended to address the various common challenges.

One significant challenge is that member states also participate in other regional economic cooperation schemes and regional political and security cooperation schemes that may compete with or undermine SADC's aims. For example, South Africa and Botswana both belong to the Southern Africa Customs Union, Zambia is a part of the Common Market for Eastern and Southern Africa, and Tanzania is a member of the East African Community.

According to Human Rights Watch, "SADC has been criticized for its laxity in making human rights compliance within its member states a priority."

What is Aquaponics?

The word "aquaponics" comes from two separate words, which are combined. The first word is "aqua", which of course, means water, but in this case, the "aqua" is from another compound word "aquaculture" (the production or raising of fish as a livelihood).

The second word is "ponics", which is Latin for work, and comes from its use in "hydroponics" (working, at growing plants in water, hydro).

Aquaponics refers to any system that combines conventional aquaculture with hydroponics in a symbiotic environment. In normal aquaculture, excretions from the animals being raised can accumulate in the water, increasing toxicity. In an aquaponics system, water from an aquaculture system is fed to a hydroponic system where the by-products are broken down by nitrifying bacteria initially into nitrites and subsequently into nitrates that are utilized by the plants as nutrients. The water is then recirculated back to the aquaculture system.

Aquaponics systems are recirculating aquaculture systems that incorporate the production of plants without soil. Intensive recirculating systems are designed to raise large quantities of fish in relatively small volumes of water by treating the water to remove toxic waste products and then reusing it.

In the process of reusing the water many times, non-toxic nutrients and organic matter accumulate.

These metabolic byproducts need not to be wasted if they are channeled into secondary crops that have economic value or in some way benefit the primary fish production system. Systems that grow additional crops by utilizing by-products from the production of the primary species are referred to as integrated systems. If the secondary crops are aquatic or terrestrial plants grown in conjunction with fish, this integrated system is referred to as an aquaponics system.

Plants grow rapidly in response to dissolved nutrients that are excreted directly by the fish or generated from the microbial breakdown (mineralization) of fish wastes. In closed recirculation systems with very little daily water exchanges (less than 5%), dissolved nutrients accumulate and approach concentrations that are found in hydroponic nutrient solutions. Dissolved nitrogen, in particular, can occur at very high levels in recirculating systems. Fish excrete waste nitrogen directly into the water through their gills in the form of ammonia. Bacteria convert ammonia to nitrite and then to nitrate. Ammonia and nitrite are toxic to fish, but nitrate is relatively harmless and is the preferred form of nitrogen for growth of higher plants, such as fruiting vegetables. It is the symbiotic relationship between fish and plants that



makes the consideration of an aquaponics system a reasonable system design criteria.

As existing hydroponic and aquaculture farming techniques form the basis for all aquaponics systems, the size, complexity, and types of foods grown in an aquaponics system can vary as much as any system found in either distinct farming discipline.

The history of Aquaponics:

Aquaponics as a food growing technology has ancient roots, although there is some debate on its first application by humans. Aquaponics is nature at work. In nature, the fish eat whatever they can find for food, and their waste is broken down by the bacteria in the water, creating nutrients for the plants. The plants then absorb these nutrients, and in doing so, they help clean the water for the fish.

The Aztec Indians of South America, cultivated agricultural islands known as chinampas in a system considered by some to be the first form of aquaponics for agricultural use, where plants were raised on stationary (or sometimes movable) islands in lake shallows and waste materials dredged from the Chinampa canals and surrounding cities were used to manually irrigate the plants.

South China and the whole of Southeast Asia, where rice was cultivated and farmed in paddy fields in combination with fish, are cited as examples of early aquaponics systems, although the technology had been brought by Chinese settlers who had migrated from Yunnan around 5 Anno Domini (years before Christ). These polyculture-farming systems existed in many Far Eastern countries and raised fish such as the oriental loach, swamp eel, common carp, crucian carp as well as pond snails in the paddies.

The 13th century Chinese agricultural manual "Wang Zhen's Book on Farming" described floating wooden rafts which were piled with mud and dirt and which were used for growing rice, wild rice, and fodder. Such floating planters were employed in regions constituting the modern provinces of Jiangsu, Zhejiang, and Fujian. These floating planters are known as either jiatian or fengtian which translates to "framed paddy" and "brassica paddy", respectively. The agricultural literature also references earlier Chinese texts, which indicated that floating raft rice cultivation was being used as



early as the Tang Dynasty (6th century) and Northern Song Dynasty (8th century) periods of Chinese history.

The development of modern aquaponics is often attributed to the various works of the New Alchemy Institute and the works of Dr. Mark McMurtry et al. at the North Carolina State University in the USA. Inspired by the successes of the New Alchemy Institute and the reciprocating aquaponics techniques developed by Dr. Mark McMurtry et al., other institutes soon followed suit. Starting in 1979, Dr. James Rakocy and his colleagues at the University of the Virgin Islands researched and developed the use of deep water culture hydroponic grow beds in a large-scale aquaponics system.

The first aquaponics research in Canada was a small system added onto existing aquaculture research at a research station in Lethbridge, Alberta. Canada saw a rise in aquaponics setups throughout the '90s, predominantly as commercial installations raising high-value crops such as trout and lettuce. A setup based on the deep water system developed at the University of Virgin Islands was built in greenhouses at Brooks, Alberta where Dr. Nick Savidov and colleagues researched aquaponics from a background of plant science.

The relevance and advantages of Aquaponics:

Aquaponics as a technology offers an opportunity to produce food in a more economically and environmentally sustainable way with produce being grown using a low level of resource-input. Aquaponics could also help to reduce carbon emissions from food production, and through shortening of supply chains, could improve food security and food systems resilience.

Local economies could be further boosted through the use of aquaponics to reclaim some of the value of their outputs. This has been demonstrated recently by researchers who used domestic wastewater to grow tomato plants and found that harmful chemicals in the water, such as ammonium nitrate, were reduced to non-toxic levels so as to be useful in agricultural and industrial systems. Furthermore, an aquaponics system could significantly reduce the amount of water used for food production compared to existing methods of agriculture.

Aquaponics in Africa is only in its infancy. Production stats on aquaponics operations are almost

non-existent due to so few systems. The systems that are known to exist are generally small scale backyard systems and those designed to feed several families.

Companies promoting aquaponics are active in Africa so there is an expectation that these systems will become more prominent over time. African countries where aquaponics is known to exist include; South Africa, Botswana, Malawi, Kenya, Zambia, and Rwanda.

Many of the initiatives are those by groups concerned about alleviating local poverty and

nutritional deficiencies. The local Aquaponics industry in South Africa is quite well organized and the Aquaponics Association of Southern Africa (www.aquaponicssa.org/) was established in 2015.

Aquaponics systems offer several advantages:

- Fish provide most of the nutrients required by the plants.
- Plants use the waste nutrients to produce a valuable by-product (second crop).



- The hydroponic component serves as a bio-filter.
- Hydroponic plants extend water use and reduce discharge to the environment.
- Integrated systems require less water quality monitoring than individual systems.
- Profit potential increased due to free nutrients for plants, lower water requirement, elimination of separate bio-filter, less water quality monitoring and shared costs for operation and infrastructure (economic value).
- Can be built close to the market, limit transportation cost and supply fresher produce to the consumer.
- Create jobs and can provide employment in areas with marginal agricultural soils
- Sustaining food security.
- Producing fish and plants that are free of chemicals, pesticides, antibiotics and growth hormones.
- No pollution of any water sources.
- Very energy efficient, only needing to pump once depending on the design of the system.

There are, of course, disadvantages to aquaponics systems. The most obvious of these is the large ratio of plant growing area in comparison to the fish rearing surface area. A large ratio of plant surface to fish surface is needed to achieve a balanced system where nutrient levels stay relatively constant. Ratios vary from 2:1 to 10:1 or greater depending on the degree of solids removal, with larger ratios needed as solids removal efficiency decreases.

Understanding Aquaponics:

Plant growth in an aquaponics system is visually and systematically vastly different from a conventional growth, in farms and the likes, the same natural requirements are in place. And although the actual science of Aquaponics is still in the early stages of its development, the biochemical cycle within it, cycling within the system, is quite well understood.

The most important is the nitrogen cycle, which in an aquaponics system is the key element cycle as it symbiotically provides fertility to plants as well as cleans the water for the fish, removing the toxicity they'd be subject to otherwise. The nitrogen cycle in this case occurs as the water flow through from the fish tanks to biological filters containing bacteria situated on submerged surface areas, to plants or a growbed and back again.

The major input into this nitrogen cycle – except for the electricity, which in this case is required for the pump to circulate the water, is fish food. The fish food can either be in the shape of an artificial fish feed or natural feed for instance aquatic plants, depending on the type of fish and plants in a given situation and the manner of intensification. After the fish eats and digests the food, they produce waste. This fish waste, as well as any uneaten fish food, starts to break down and, from this, the majority of the nitrogen content form ammonia (NH3). This ammonia is then, thereafter as it flows through the biological filter where Nitrosomonas bacteria is situated, converted to nitrite (NO2) after which a second type of bacteria, Nitrobacter, converts nitrite into nitrate (NO3). This nitrate then, as it flows through the growbed, serves as a fertilizer for the plants therein. As such the plants, in this hydroponic component of the system, take up the nitrate that helps them grow by removing it from the water and as such purifies it as it circulates back to the fish tank returning clean, fresh water for the fish to thrive in.

In general almost any freshwater fish and shellfish can be cultivated using aquaponics. Similarly, a wide range of plants can be grown in this kind of system.

It is, however, easier to grow plants that do not have large roots that might cause them to rot, depending on what system-flow you utilize. More information about plant varieties will follow later in the course. Plants within a low to medium nutrient requirement tend to do best.

The need for Agricultural Training:

An analysis performed by the Agricultural-Sector Education Training Authority (Agri-SETA) in 2010 identified a range of scarce skills in agriculture. At small-scale level, it was found that farmers lacked skills in a host of areas: farm management and entrepreneurship, resource management and record-keeping, financial planning and management, marketing, processing and packaging, transport, natural resources management, and mechanical and electrical knowledge.

In the commercial sector, the critical constraint identified was the poor educational levels of a large proportion of the labour force, which demanded a considerable investment in adult basic education and training and other life-skills programmes.



Agri-SETA also found that commercial farmers needed to improve their management and business and marketing skills, develop more environmentally responsible production and processing systems, raise environmental, health and safety compliance, and make more progress towards meeting international trade standards.

Prof Mohammad Karaan, the previous dean of the Faculty of AgriSciences from Stellenbosch University believes that any industry that advances does so from the basis of investment in people and technology. "If we're going to build an agriculture sector that will help grow the sector, we have to invest in human capability," he notes. "We're not generating enough of that. We're certainly not generating enough black talent to create a class of black agricultural professionals. We need human capacity to fuel prosperity in the sector."

The Digital Aquaponics Training Program:

The interdisciplinary nature of aquaponics may make it an appealing tool for education, yet that same aspect may also make an aquaponics system challenging to implement and manage. Educators require appropriate training materials and training courses for their particular educational settings. DESERTFOODS International GMBH and partners in South Africa aim to develop digital and interactive aquaponics study programmes across the SADC region by way of a hybrid teaching approach comprising of pre-academic online courses, scientific graduate studies, live practical training workshops and accompanying formats such as virtual workshops.

The main teaching media for the Study Programme are digital tools such as cell phones, tablet PCs, notebooks and desktop PCs. As far as possible, teaching didactics shall use any form of visualization. This includes video, audio, graphics, animation, virtual reality, best-practice scenarios, and e-scripts.

Sole teaching language shall be English. The partners are hundred percent aligned that a well-balanced split between theory and practice is essential with the 'train with purpose approach' representing the core of criteria for all courses and events to be deployed under the Study Programme. Students are expected to spend a minimum number of practical hours on aquaponics farms ('Farms') either operated as demonstration, R&D and competence facility or commercial at-scale food production facility. Practical hours can count towards temporary or full-time placement and shall facilitate employment. Practical and vocational training shall be considered as part of mentoring and tracking student progress to meaning employment or business development. To impart cutting-edge know-how and technology the Farms shall meet certain standards both system and design-wise. The profile of the scientists and practitioners acting as virtual lecturers and/or on-site trainers shall also meet certain prerequisites with criteria catalogue to be jointly defined by the partners.

The course attendees of the Study Programme shall comprise a socially diverse student population representing a key component of the accomplishments the partners are jointly aiming to

achieve with the Cooperation. To provide access to the Study Programme and secure a more diverse range of students, the partners jointly intend to provide financial assistance to individuals originating from an underprivileged group and/or (previous) disadvantaged community. Students with outstanding records of academic and/or practical achievements shall be given special consideration and encouraged to apply for e.g. a scholarship.

While the tuition fees of running the courses of the Study Programme require that those students who can pay full fees must do so, every academic year the Parties shall provide a number of bursaries to individuals encountering financial difficulties in affording the attendance of course under consideration. Notwithstanding the above, a tuition fee shall be attached to all course offerings of the Study Programme. In order to meet high-quality standards of the Parties and to operate a viable impact business, the level of enrolment fees shall strongly interrelate with the profile of the target audience as well as the scope of knowledge transfer and duration of the course. Students of the Study Programme shall regularly be invited to evaluate individual courses by way of an online questionnaire allowing for an on-going enhancement of the study material and its presentation both content and haptic wise.

The Parties are mutually committed to implement the highest compliance, ethical and reporting standards at each level of the Study Programme.

Regular assessment shall be conducted to guarantee the financial soundness of the Study Programme, above all the academic quality and the educational autonomy.

Conclusion:

In the future, the nucleus of the Study Programme's digital education shall be a (web-based, cross-platform or hybrid) software application ('APP') that will uniform different interfaces on a single platform such as administration (i.e. enrolment, course registration, download of study material, execution of exams, attendance records, communication with lecturers etc.), encyclopedia (AquaponicWiki, FarmingWiki) as well as features and tool-sets contributing to a unique user experience and high retention rate (e.g. chat features, access to webcams broadcasting live pictures from the Farms) among students and other stakeholders of the Study Programme.

The partners shall mutually consider each other Party on par with a strong commitment to pooling academic excellence with state-of-the-art farming practice and entrepreneurial spirit to the benefit of the participants of the Study Programme with the students being considered as the Cooperation's largest and most important stakeholder group. The common goal is to create food security, new job opportunities and long-term sustainability through multi-loop aquaponics farming practices in harmony with nature.



Carbon storage in agricultural soil

Corrie Swanepoel

Abstract

Ecologically, soils provide a range of ecosystem services, such as nutrient cycling, carbon sequestration, water filtration and storage, and are therefore considered an integral part of many natural systems.

Soil organic matter, or its indicator elements, carbon and nitrogen, are often equated with soil quality. However, cultivation of soils negatively influences the carbon content of the soil. Soil organic carbon can be converted into carbon dioxide when changing land use from natural vegetation to cultivated land, contributing to greenhouse gas emissions. In this article we explore the dynamics of soil carbon, how it is impacted by agriculture and what best management practices can help conserve carbon in our soils.

Introduction

Interestingly, soil lies at the heart of many seemingly unrelated issues, such as food security, human health,

climate change, biodiversity and degradation of natural resources. Maintaining soil quality is essential in ensuring sustainable agriculture, as well as human and environmental health. While agriculture (and soil) are key in challenges such as food security and economy, the practice thereof can degrade the soil and natural resources and contribute to climate change. Seemingly, with agriculture we are damned if we do, and damned if we don't. Or are we? At the heart of this problem (or solution), is essentially the story of carbon. Lets first look at where carbon in the soil comes from and what it does.

Soil organic carbon

Almost half of the dry matter from plants consists of carbon, and this mostly comes from atmospheric carbon dioxide that is converted into biomass and energy through photosynthesis. Most other nutrients and water are derived from the soil and absorbed through the roots. This was not always very obvious.

In 1634, Belgian Jan Baptist van Helmont debunked the idea that plants grow because they eat soil. Jan famously conducted the first quantitative scientific experiment when he weighed a small willow tree and some soil, planted the willow in that soil, watered it regularly, and after five years weighed the willow and soil again. The tree gained about 74 kg, but the weight of the soil stayed the same. His conclusion? Plants do not consist of soil, but are in fact made up of water.

Although his conclusion was wrong, his methods were sound, and laid the ground work for scientific experimentation that has led to what we know today.

Organic matter decomposes in the soil by means of microbes and other biological processes, returning nutrients to the soil, but also releasing gases in the process. This is the start, or maybe the end of the carbon cycle (but also other elements such as nitrogen and potassium, as they too travel through the soil as part of their life journey). We use carbon content as a proxy for soil fertility. High carbon content is associated with higher nutrient status, increased soil stability and thus reduced erosion or crust formation and better infiltration. Carbon itself has a high specific surface area that increases the cation exchange capacity of the soil, and can thus 'hold on' to nutrients in the soil. But also, during decomposition when carbon is released, so too are other organic nutrients which increase nutrient status and stimulate microbial activity. The amount of carbon that is retained in the soil is a function of the organic matter input (vegetation), the climate (temperature and rainfall) and the soil type



(particularly the clay content). Many South African soils have very low natural carbon due to the high temperatures and semi-arid regions with sparse vegetation. Any change in management can change the stored carbon in the soil. For example, cultivating the soil results in increased oxidation, changes in



soil temperature and water content and therefore increased decomposition rates and increased carbon losses through carbon dioxide emission. In South Africa, we estimate that, depending on the agro-ecological zone, the loss of soil carbon due to cultivation ranges from 25-48%.

Greenhouse gas emissions

Another interesting thing to know about soil carbon, is that soil is the largest terrestrial carbon sink, and there is more carbon stored in soils than in the atmosphere and plant biomass combined. This makes carbon sequestration in the agricultural sector one of the more promising strategies to tackle climate change.

If we can get the carbon out of the atmosphere where we don't want it, into the soil where we very much want it, it would be a win-win situation. Considering that up to half of the natural carbon has been lost due to cultivation, there seems to be plenty of space to sequester more carbon.

Depending on the source, agriculture contributes about 6-14% of our national greenhouse (GHG) emissions. Agricultural emissions are a combination

of GHG emissions from cultivated soils and animal husbandry, both making up about half of the total.

Cultivated soils mostly release GHG in the form of nitrous oxide, a result of nitrogen fertilizer, while carbon dioxide emissions result from conversion of natural soil to other land uses.

Conservation practices

In our quest to sequester carbon in the soil, we turn to management practices such as conservation and regenerative agriculture. These movements aim to improve soil quality by practicing methods that conserve or increase soil organic carbon. These include reduced or zero-till, mulching or permanent soil cover and crop diversification. Added measures can include reduced traffic to minimise soil compaction and inclusion of livestock to facilitate nutrient cycling.

By reducing soil disturbance, the carbon in the soil is conserved, and additional biomass is introduced through crop diversification and soil cover. Soil cover does not only include compost or mulch; particularly interesting is live soil covers or green manure, which has the advantage of living roots. Live roots helps

prevent soil compaction, contributes to nutrient cycling and stimulating soil microbes, to name a few.

An effective soil cover helps to protect the soil surface thereby creating a favourable microclimate, reducing erosion and regulating soil temperature.

Carbon positive practices

We know that forests and peatlands are some of the most "carbon-rich" systems. Conversion of these land types to cultivated land results in significant carbon losses. However, grass or pastures also have a high capacity to store carbon. In fact, grasslands can overtake forests in terms of carbon storage in some situations. In stable conditions, forests can store more carbon, but in vulnerable, warming future conditions, we might lose part of this highly productive ecosystem, especially with increased fires and dry spells. In these cases, grasslands can be a highly effective and resilient carbon sink. Unlike forests, grasslands have a more expansive and intensive root system, sequestering most of the carbon in the soil, making it more resistant to carbon loss during fires or drought. The fact that grass has an annual cycle, results in roots dying (and decomposing) directly in the soil, sequestering carbon at deeper levels, while new growth keeps on adding more roots and grass biomass every year.

In South Africa, grasslands are much more abundant than forests, making this a viable and promising climate solution. Research also shows that when land use is changed from cropland to pasture,

carbon losses can very effectively be mitigated and increased. Part of grassland or pasture management is grazing. For this reason, livestock inclusion, that facilitates nutrient cycling of above ground biomass, complements the array of climate-smart practices. So while agriculture often contributes to greenhouse gas emissions, it is also one of the most promising solutions to climate change. The challenge is thus to find the best ways to increase carbon in each region and/or ecosystem.

Acknowledgements

Thank you to Dr Hendrik Smith and Ms Christa Lombard for sharing their pictures.



South Africa's agriculture export drive is not a straight forward path

Wandile Sihlobo

There is consensus amongst agricultural role-players that sustainable growth in South Africa's agricultural sector cannot only be achieved through the expansion of production. An expansion of export markets should be a key support pillar for growth.

This has been well understood for many years. For nearly three decades, South Africa excelled at opening various export markets, supporting the growth the sector has witnessed since 1994. South Africa has successfully negotiated several free trade agreements (FTAs) over the past few decades with critical regional and international markets. These include the following:

1. Southern African Development Community (SADC) FTA,
2. SADC-European Union (EU) Economic Partnership Agreement (EPA),
3. SACU/Mozambique-United Kingdom (UK) EPA,
4. The African Continental Free Trade Area (AfCFTA)
5. and SACU-MERCOSUR Preferential Trade Agreement (PTA).

As I have noted previously in these pages before, all the agreements highlighted above were concluded over the past 16 years, which is quite a considerable feat given the technical and institutional demands that must be committed to negotiating and successfully implementing trade agreements.

I should note, however, that the actual free trade agreements are in only two of South Africa's biggest markets – Africa and Europe – which collectively account for two-thirds of the country's total agricultural exports in value terms.

The SACU-MERCOSUR preferential trade agreement (PTA) is a narrowly focused and low-ambition trade arrangement and has not had a significant impact. That said, it could be argued that the opening of markets through these agreements has indeed deepened, consolidated and improved South Africa's position in the EU and Africa.

Recently, we have seen a rise in the use of non-tariff barriers in these critical markets, such as the regulation of citrus exports in the EU and the ban of vegetable imports from South Africa in Botswana and Namibia.

This means the South African authorities and industry will need to collectively work towards strengthening our relations in these markets and restoring the export position the country has enjoyed for some time.

Simultaneously, South Africa would be best served by diversifying its export markets beyond Africa and Europe. The Middle East, the Far East (Asia), and North and South America currently account for roughly a third of South Africa's agricultural exports.

This is perhaps where most of the attention and pursuit of free trade agreements would be more beneficial. Some of South Africa's fiercest competition amongst various products is from Chile, Peru, Australia, Argentina, New Zealand, and Uruguay. They have struck trade agreements with most markets in Asia, the Middle East, and the Americas.

Meanwhile, South Africa has not and faces higher tariffs against the key competition and local producers have to overcome these tariffs primarily through farm-level technical efficiency.

Still, South Africa does not have to follow the same path as the countries above and open various free trade agreements. South Africa is an industrialising economy with a unique set of challenges and with various domestic industries requiring some protection.



South Africa could target low-ambition trade agreements with specific countries, primarily Preferential Trade Agreements, which focus on liberalising a specific set of commodities and agro-processed products. There is very little chance of South Africa embarking on deep and extensive tariff cuts on goods and services, especially given that the costs of opening up markets cannot be determined with certainty.

In this quest to widen South Africa's agricultural exports, even within a narrow path, the priority countries should be China, South Korea, Japan, the USA, Vietnam, Taiwan, India, Saudi Arabia, Mexico, the Philippines and Bangladesh.

These countries have a sizable population and large imports of agricultural products, specifically fruits, wine, beef and grains. These countries are already on the radar of the South African authorities. At the same time, South Africa should not neglect the continuous constructive engagements with Europe and the African continent as we search for new markets.

Aside from the broad trade policy themes, efficiency in the logistics industry remains a crucial area. The sector engages with Transnet and

Infrastructure South Africa and various government departments responsible for roads for this particular goal. There also needs to be increased security within the logistics as we see increased reported cases of criminality against South Africa's infrastructure.

Despite all these challenges, the interventions made by Transnet, industry and government have again yielded positive results on agricultural exports thus far. In the data we have for the first eight months of this year, South Africa's agricultural exports amounted to US\$8,9 Billion, up by 6% from the first eight months of 2021.

The generally higher commodity prices have also contributed to this increase in exports values. In these months, the African continent and Europe remained vital markets, underscoring the points we argued above. Citrus, maize, nuts, wine, sugar, apples and pears, and grapes were among the key exports, especially in the latter months under consideration.

South Africa's agricultural trade approach is not one-sided. The country also imports a range of products. The imports for the first eight months of 2021 amounted to US\$5,1 Billion, up 13% from the same period in 2021. Palm oil, rice, wheat, and spirits were amongst the essential imported products, specifically in the later months of this measured period. The key suppliers included the likes of Indonesia, Thailand, Romania, China, Argentina, Poland and Germany.

Overall, South Africa's agricultural growth path needs a focused trade policy strategy, but this should not be at the expense of existing agreements that have sustained the sector over the years.

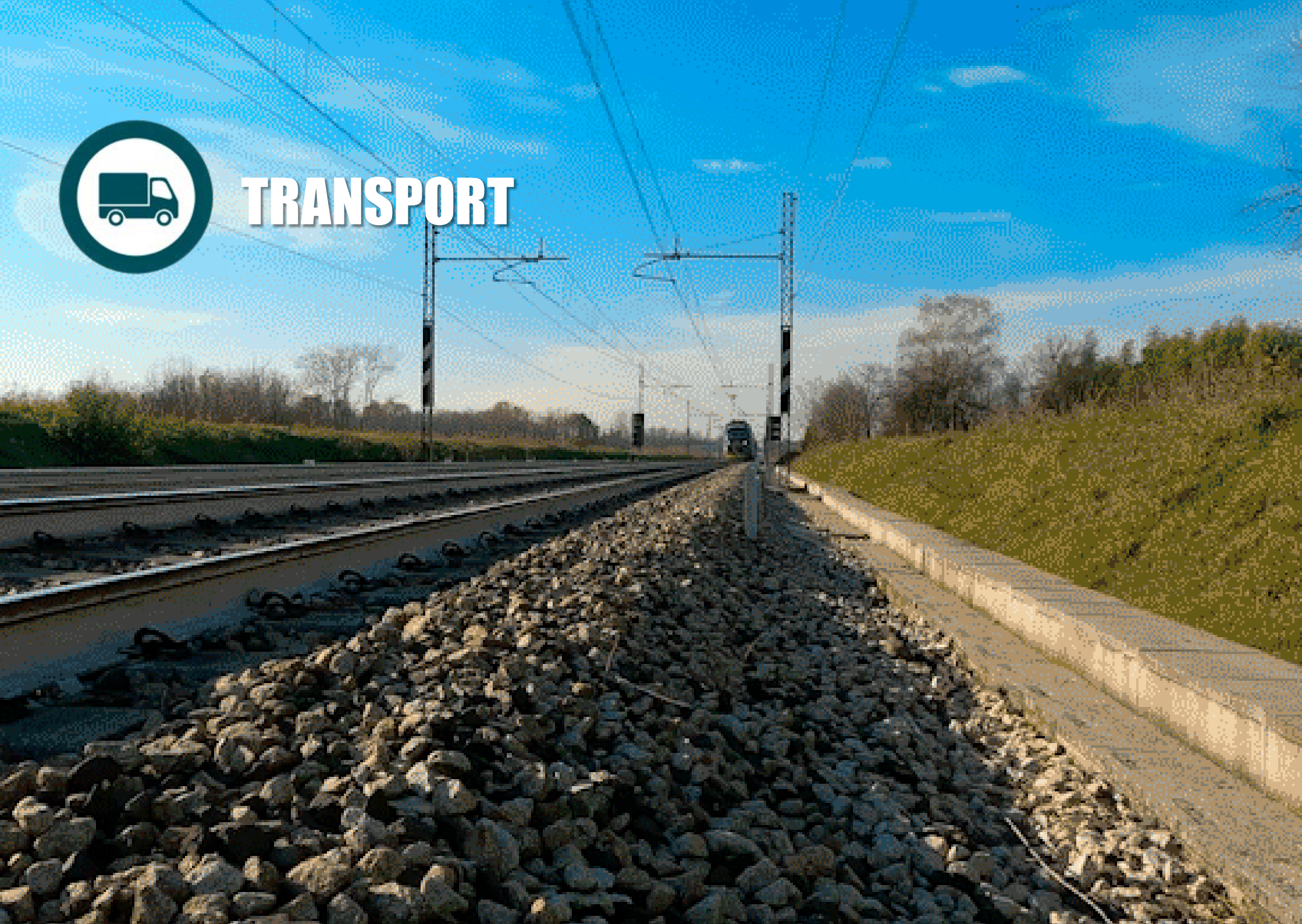
The industry and government should work collaboratively on strengthening the current markets through continuous engagements at the political and business level while simultaneously exploring new and promising markets.

Ongoing conversations and collaboration between industry and logistics entities like Transnet are also crucial for the success of the export strategy. Logistics efficiency improvement is an integral part of the agriculture growth agenda that will ultimately deliver jobs and economic activity in rural South Africa.





TRANSPORT



Transport and Mobility

Hiten Parmar

With air pollution one of the biggest threats to human health – and 90% of the global population breathing unsafe air – accelerated electric vehicle deployments across world markets target poor air quality within cities, combatting increasing direct and indirect respiratory-linked deaths due to the combustion of petrol and diesel across the transport sector. Electric vehicles not only have zero tailpipe emissions but are also significantly more energy-efficient (up to

60% more) and lower total cost of ownership when compared to traditional petrol and diesel vehicles.

By mid-2022, a total of 1,852 plug-in electric vehicles had been sold in South Africa, of which 1,068 were full battery electric and 784 plug-in hybrid electric. During 2019, full battery electric overtook plug-in hybrid electric market share with continued exponential growth showing that local consumers have developed better confidence with the available driving range in

newer vehicle models, as well as the wider available public charging infrastructure network across the country. The country has also noted use cases of electric buses and heavy-duty trucks as other vehicle segments beyond just passenger vehicles.

Air pollution, referenced as a silent killer, continues to pose one of the most significant global threats to human health, with World Health Organization (WHO) estimates indicating it is responsible for around 7 million deaths annually. More than 80% of the world's population live in urban areas where pollutant levels exceed WHO guideline limits. Air pollution has a

significant impact on human health, increasing risks of respiratory diseases, heart disease, lung cancer, and low birth weight (among others). Children and the elderly are particularly vulnerable, placing an even greater burden on the healthcare system with substantial medical costs to which the South African Green Transport Strategy also acknowledges.

Road transport in South Africa, as being the primary source of transport-related CO₂ emissions, contributes 91.2% of total transport greenhouse gas emissions, primarily from the combustion of petrol and diesel. Compounding this is the poor fuel quality

distributed within South Africa which is at Euro 2 level (globally introduced in 1997), while many countries worldwide are at Euro 5 and 6 levels. An earlier study revealed that South Africa's transition from Euro 2 to Euro 6 fuels would decrease greenhouse gas emissions by just 12%. A transition to electric vehicles, while charging through the existing energy mix would reduce emissions by 34%. Charged by a zero-carbon mix, electric vehicles would reduce South Africa's greenhouse emissions by 67%.

As a historic reference of the automotive manufacturing industry in South Africa, it has existed

since the first production plant began in Port Elizabeth with the assembly of the Model T Ford in February 1924, making 13,000 units in that year. Pre-COVID, 631,983 vehicles were manufactured locally with the automotive industry contributing 6.4% to Gross Domestic Product.

The growth of the automotive manufacturing industry has leveraged off government's production incentive schemes for the automotive industry aimed at promoting production volumes, added value in the automotive component industry and creating employment across the local automotive value chain. Passenger car manufacturing plants within South Africa include BMW, Ford, Mercedes Benz, Nissan, Toyota and Volkswagen - all centred to traditional powertrain technologies of petrol/diesel. In 2016, Mercedes Benz South Africa was the first locally to advance into alternative technologies with the manufacturing of the C-Class plug-in hybrid electric variant at the East London plant. Toyota South Africa have since commenced with local production of the Corolla Cross hybrid in Durban.

In terms of the government's production incentive schemes the Automotive Production and Development Programme (APDP) implemented in 2013, has had no direct incentive for South Africa's competitive edge for alternative technologies in keeping aligned to global automotive technology advancements. With many countries and cities worldwide announcing plans for the banning of petrol/diesel vehicles, South Africa needs to review the market longevity of the vehicles manufactured locally.

As 60% of vehicles manufactured in South Africa are exported to the European Union – and many of these countries implementing the referenced bans of fossil fuel from as soon as 2025, will our fellow African states need to become the next frontier market for South African-built petrol/diesel vehicles in the future? African countries could also be proactive in joining the global climate action movement and leapfrog into embracing electric vehicles, capitalising on abundant renewable energy and offset imports of fossil fuels.

Price parity for battery electric vehicles with their petrol and diesel counterparts is forecast to occur between 2023 and 2025 as manufacturers accelerate production output to meet consumer demand. As South Africa is reliant on imported electric vehicles, low market volumes locally are a direct correlation of



affordability based on the current tariffs within the automotive policy regime.

The European Union is South Africa's largest trading partner, and the SA-EU Economic Partnership Agreement governs trade relations and development co-operation on bilateral trade in the current framework. Under the current tariff structure, petrol/diesel passenger vehicles manufactured in the EU and imported into South Africa attract 18% customs duty, where electric vehicles attract 25%. This is an immediate 7% price barrier on electric vehicles within South Africa. Additionally, structured within the recommended retail price of the vehicle is the Ad Valorem duty and Value-Added Tax. For markets outside the EU, the customs duty of 25% is applicable across all types of vehicles - petrol/diesel/electric.

Low sales of electric vehicles are also attributed to consumers' perceived anxiety on the lack of public charging stations. From use cases worldwide, predominantly 60 - 70% of charging takes place at home, typically overnight. Electric vehicles are also supplied with a convenience charging cable that allows charging from any standard residential outlet like other home appliances providing the convenience to charge from existing electricity supply outlets within homes and businesses.

Faster charging rates are achieved from public chargers and, depending on the vehicle and charger rating, typical charge times vary from 25 minutes to 6 hours. Charger ratings are usually matched to the time frames of consumer parking at the specific location, and some locations may be strategically planned for fast charging, typically on and off highways or shopping malls within the city.

South Africa has a positive footprint of public charge points enabled by multiple initiatives. Through the international community-based platform PlugShare, South Africa lists over 300 public chargers across the country, predominantly across specific locations within cities and major highways.

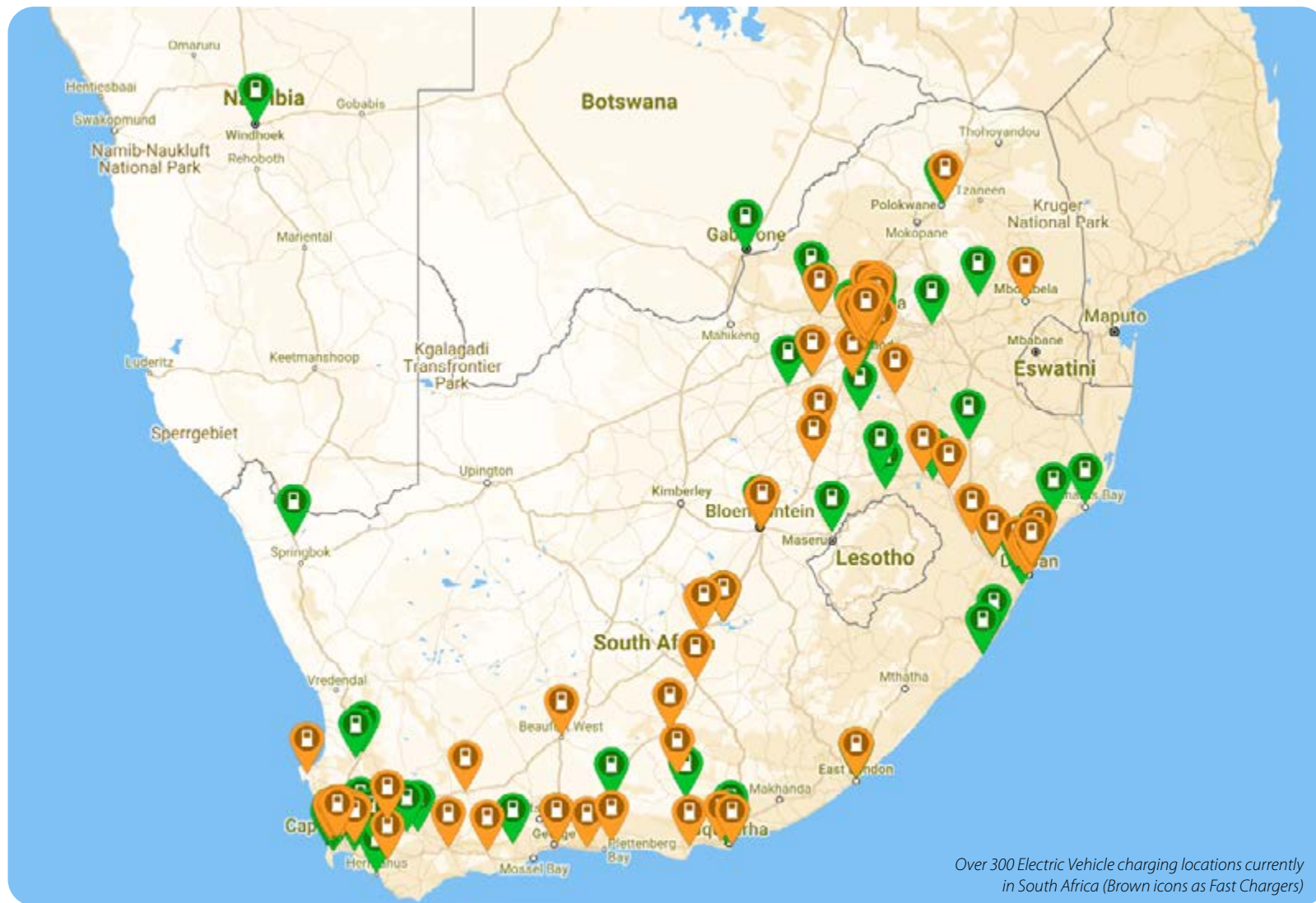
As an energy capacity forecast, along a simulated model of energy supply in South Africa and using the average 5% global electric vehicle fleet match in South Africa, it would correlate to approximately 0.5% of peak energy demand. While electric vehicles consume grid energy during charging, through the supporting

technology within the vehicle and equipment, the large internal battery packs can provide ancillary grid services through Vehicle-to-Grid and also supplement energy within homes through Vehicle-to-Home.

As a signatory to the Paris Agreement under the United Nations Framework for Climate

Change Convention adopted in December 2015, South Africa is committed to a 'peak, plateau and decline' emission trajectory through its Nationally Determined Contributions. Broader policy frameworks need to be aligned towards addressing the global climate action within the context that

South Africa faces the challenge of climate change as a developing country, with priorities to reduce poverty and inequality. South Africa still lags behind worldwide efforts to accelerate electric vehicles into the market, both from local manufacturing competitiveness and a local car park.



Over 300 Electric Vehicle charging locations currently in South Africa (Brown icons as Fast Chargers)

Using systems dynamics modelling to facilitate sustainable decision making and improved planning and implementation of integrated public transport networks (iptn) as effective spatial transformation instruments in South African cities

Mashudu Rathogwa and Mathetha Mokonyama

Integrated Public Transport Networks (IPTNs) can contribute positively towards spatial transformation. The rate at which this is feasible is contingent upon the nature of decisions made by planning agencies, households, and businesses. This chapter demonstrates the use of a systems dynamics modelling platform to simulate the dynamic fusion of decisions (and non-decisions) by the various role players who influence the performance of IPTNs, as well as the effect of their decisions on the performance trajectory of IPTNs as spatial transformation instruments in South African cities.

The research demonstrates that underestimating and mismanaging the inherent interdependencies of the decisions made by the actors in the development

and execution of IPTNs can have a substantial impact on the rate of spatial transformation. In order to turn around the sustainability trajectory, a city will need to investigate various interventions while keeping “an eye out” for any unintended consequences of decisions and the prospective repercussions of the interventions. In this sense, the model turns into a tool for facilitating discussions among stakeholders who are interested in the results.

Introduction

This chapter demonstrates the use of a systems dynamics modelling platform to simulate the dynamic fusion of decisions (and non-decisions) by the various role players who influence the performance of IPTNs, as well as the effect of their decisions

on the performance trajectory of IPTNs as spatial transformation instruments in South African cities in ways that contribute to a sustainable transport system.

In accordance with a definition of a sustainable transport system presented by Holden et al. (2013), a spatially transformed city is considered a city progressing with regards to a sustainable transport agenda, which seeks to maximise, concurrently, inter-generational equity, intra-generational equity, long-term ecological sustainability and also satisfies basic human needs. In addition to the definition advanced by Holden et al. (2013), which is essentially founded on the outcomes of the World Commission on Environment and Development (WCED, 1987), a spatially transformed city adopts financially viable transport solutions.

A systems dynamics modelling framework is considered appropriate because urban transport systems are complex (Rodrigue, 2020). In particular, overcoming the apartheid spatial planning legacy in South Africa will most certainly require the use of tools beyond those used in traditional transport planning.

Observations by the authors suggests that transport planning in South African cities tends to be a discrete undertaking, with little functional interaction with other built environment disciplines, to the extent that transport planners rely on deterministic planning tools with little or no feedback mechanisms. Such a fragmented planning approach limits the transport system capacity to meaningfully contribute to spatial transformation, which is inherently a multidisciplinary problem.

Methodically, the chapter provides the approach process adopted to build a systems dynamics model to evaluate the transport system's capacity to transform spaces, and further discusses selected results for illustration purposes. Primarily, the chapter answers two questions: (1) To what extent do systems dynamics modelling platforms offer a better alternative to established transport planning tools on the subject of spatial transformation, if any?, and (2) What methodological weaknesses should be overcome by systems dynamics modelling framework for wider adoption in spatial transformation modelling?

Background

The preamble of the National Land Transport Act (Act 5 of 2009) (NLTA), which is cardinal legislation for land

transport in South Africa, makes a political statement that the purpose of the Act is: “To provide further the process of transformation and restructuring the national land transport system initiated by the Land Transport Transition Act of 2000”. Implicitly, the statement requires land transport to be treated as a system, and further acknowledges that the necessary transformation and restructuring of the system are processes. Although the NLTA does not define transformation, in the context of this chapter spatial transformation is change necessary to give effect to the Constitution of South Africa, including what the Constitution refers to as freeing the potential of every person, and having an environment that benefits present and future generations. It is imperative for transport planning authorities to demonstrate that when plans are implemented, they will free the potential of each person, and also create an environment that will benefit both the present and future generations.

The work draws from project-specific conversations, within the National Treasury's Cities Support Programme (CSP), between the authors and officials in five South African cities, namely Ekurhuleni, Johannesburg, Buffalo City, Nelson Mandela Bay, and Mangaung, which are among cities implementing integrated public transport networks (IPTNs). In terms of the National Land Transport Act (Act 5 of 2009), IPTNs promise to “integrate public transport services between modes, with through-ticketing and other appropriate mechanisms to provide users of the system with the optimal solutions to be able to travel from their origins to destinations in a seamless manner”. Since 2007, the South African government has invested billions of Rands every year to implement IPTNs (Cities Support Programme, 2018). Politically, questions about the scope for such an investment to transform urban spaces to dismantle the apartheid legacy remain largely unanswered by traditional transport planning methods, which are mainly designed to guide budgeting for infrastructure delivery (Cities Support Programme, 2018).

Literature review

The use of traditionally fragmented and mechanistic science is not able to cope with complex, self-organising systems about sustainability which require non-linear and organic thinking of systems thinking

(Hjortha and Bagheri, 2005). As a corollary, improved understanding of how different components of a system work together, is necessary for improved understanding of the system.

The emergence of systems thinking as a discipline since the late 1950s has gone through an evolution from basic mental models to the introduction of modelling software that is able to simulate system behaviour (Richardson, 1996). Nonetheless, simulation models are constructed based on causal loop diagrams, which represent causal linkages between elements that make up a system (Richardson, 1996).

In essence, therefore, a causal loop diagram is a mental model representation of how elements of a system cause each other to change over time, and in that way represent system behaviour.

Torres (2019) provides an extensive bibliometric review of the application of systems dynamics in complex problems. Shepherd (2014) conducts a bibliometric review of system dynamics application in transport. In southern Africa, Rich et al. (2018) illustrates how systems dynamics can improve participatory approaches for stakeholder inclusion in urban and peri-urban agriculture planning. Mupfumira et al. (2015) present a model liberalization impact of public transport in the city of Harare. Das (2020) models the possible trajectory of Bloemfontein as a smart city.

Van de Merwe et al. (2015) model opportunities for reducing greenhouse gas emissions as it relates to the shift of freight from road to rail. Jonker et al. (2017) used a system dynamic methodology to model the implications of biofuel production in the Western Cape Province. These authors agree that systems dynamics modelling offers potential for improved understanding of complex problems, including those found in the transport system.

The complexity of spatial transformation in South Africa (Maritz et al., 2016) could lend itself to be explored through the use of systems dynamics modelling. In South Africa, however, there does not seem to be a case study to date, that has explored the use of systems dynamics for modelling spatial transformation, particularly as it relates to the contribution of transport and mobility. Therefore, using system dynamics modelling may contribute to answer longstanding questions such as “Are We Achieving Spatial Transformation in South Africa?”

(Maritz et al., 2016); and to complex interrelationships between state policies and practice identified by Todes and Harrison (2015).

Methodology

The research work commissioned by the CSP sought to create a systems dynamics model able to simulate the dynamic contribution of a city’s transport system to spatial transformation, in the form of an integrated public transport network. The contribution of the city’s transport systems was considered highly correlated with a sustainable transport system as defined by Holden et al. (2013) which is captured in the form of Table 1. The metrics proposed Holden et al. (2013) for the transport system are methodically constructed to be equivalent to the United Nations’ “Our Common Future” report (WCED, 1987) metrics.

The year 2030 is selected for the purpose of reporting on Sustainable Development Goals. In addition to the metrics proposed by Holden et al. (2013), through conversations with officials from South African cities, a further metric on the financial viability of the public transport solutions was added.

Financial viability is defined as the extent to which a public transport can cover its operating costs from operational revenue, with a target of 100 per cent.

Furthermore, for South African cities, the requirement of satisfying basic human needs through provision of a minimum of 9.2 motorised kilometres per capita per day was considered unnecessary, since it is already met for South African cities. Public transport accessibility level is a composite measure comprising variable characterising quality and level of access to public transport (500m physical access to a service with 30 minute headways; fatal road crashes per 100 000 population; perception of security; public transport service speed; perception of quality of public transport service information; perception of quality of infrastructure for persons with disabilities; perception of quality of non-motorised transport infrastructure; and proportion of household income spent on public transport) (Holden et al. 2013). Each of the constituent variables are normalised to system targets, such that they add to a maximum of 1.

A composite index, referred to as an IPTN sustainability index is a weighted sum of four key variables, namely: (i) financial viability; (ii) daily per capita energy consumption for passenger transport;

Dimension	Overall indicator	Equivalent transport system indicator	Estimated 2030 threshold
Safeguarding long-term ecological sustainability	Yearly capita ecological footprint	Daily per capita energy consumption for passenger transport	Maximum 5.6 kWh per capita per day
Satisfying basic human needs	Yearly capita GDP purchasing power parity	Daily per capita travel distance by motorised transport	Minimum 9.2 km per capita per day
Promoting intra-generational equity	Gini coefficient	Public transport accessibility level	Public transport accessibility of 3
Promoting inter-generational equity	The amount of renewable to total energy production	The amount of renewable to total energy used for transport	Minimum of 15%

Table 1: Metrics for a sustainable transport system. Source: Holden et al. (2013)

(iii) public transport accessibility and (iv) the amount of renewable to total energy used for transport level.

Each of the variables are normalised to targets, such that they add up to a maximum of 4. Turning around the city’s sustainability trajectory is computationally represented by the IPTN sustainability index. A city turning around its transport system experiences consistently increasing values of the IPTN sustainability index at some point during the modelled period.

A systems dynamics model itself is a system of difference equations in which variables considered stocks (reservoirs) represent a cumulative state that is affected by inflow variables controlled by valves as well as outflow variables that are also controlled by valves. For each time step (one year in the context of the case study model) the state of each variable in the system is computed through numerical integration, based on relationships that have been coded. STELLA systems dynamics software was used for the purpose. The software has found wide ranging applications reported by Bala et al. (2017).

Other variables of interest embedded in the model, that are specific to the system being modelled, include household formation rate; trip length distribution; development density; energy intensity; agility of the city; capability of the city; unit transport cost; city’s budget relative to need.

Prior to model development, a series of technical workshops were held with officials from each city to construct causal loop diagrams representing the contribution of transport to spatial transformation. A version of one of the causal loop diagrams is depicted in Figure 1.

The causal loop diagram was translated to a systems dynamics model, whose structure is depicted in Figure 2. The model was calibrated using various datasets for each city, and well as relationships from literature or secondary datasets. Where relationships could not be established, such variables became scenario variables.

The model is typically run for a 15-year period 2015/16 to 2030. Validation is achieved through retrospectively confirming the values of variables for time periods that have already passed.

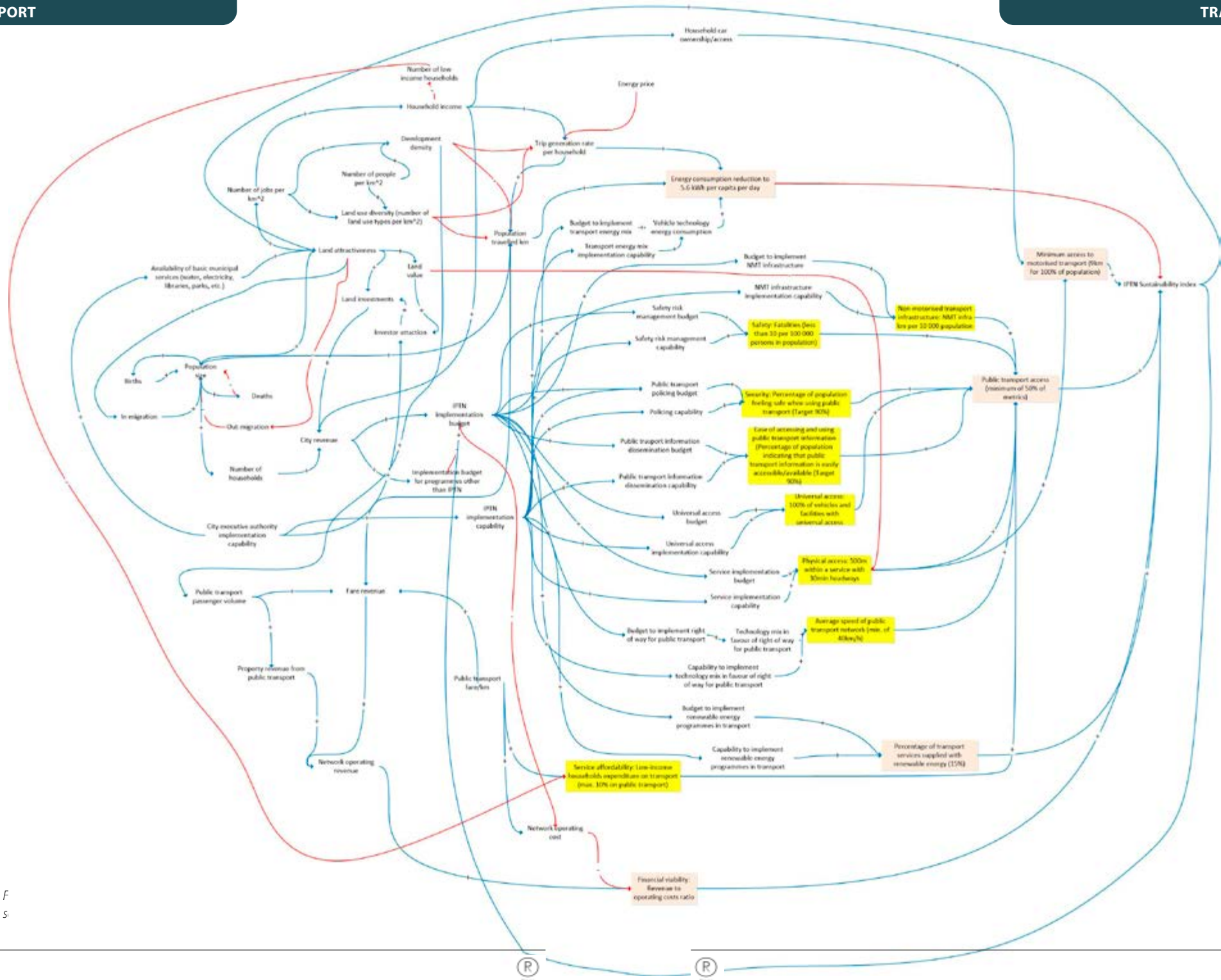
Results

The IPTN sustainability index in the model is constructed to assess the extent to which the transport system contributes to sustainable outcomes in a city. Computationally, the index is a composite measure combining effects of decisions (and non-decisions) made by various actors in the system and associated feedbacks over a period of time as it relates to financial performance of the transport system, passenger transport energy consumption, public transport access and the use of renewable energy in the city’s transport system.

Figure 3 depicts selected baseline model outputs over a period of 15 years, showing on the one hand values of the individual variables forming part of the IPTN sustainability index, and on the other the actual value of the IPTN sustainability index.

In the specific case depicted, representing a business-as-usual decision making, indications are that, over time, transport systems’ contribution to sustainable outcomes diminishes. Such a business-as-usual scenario is characterised by ways of





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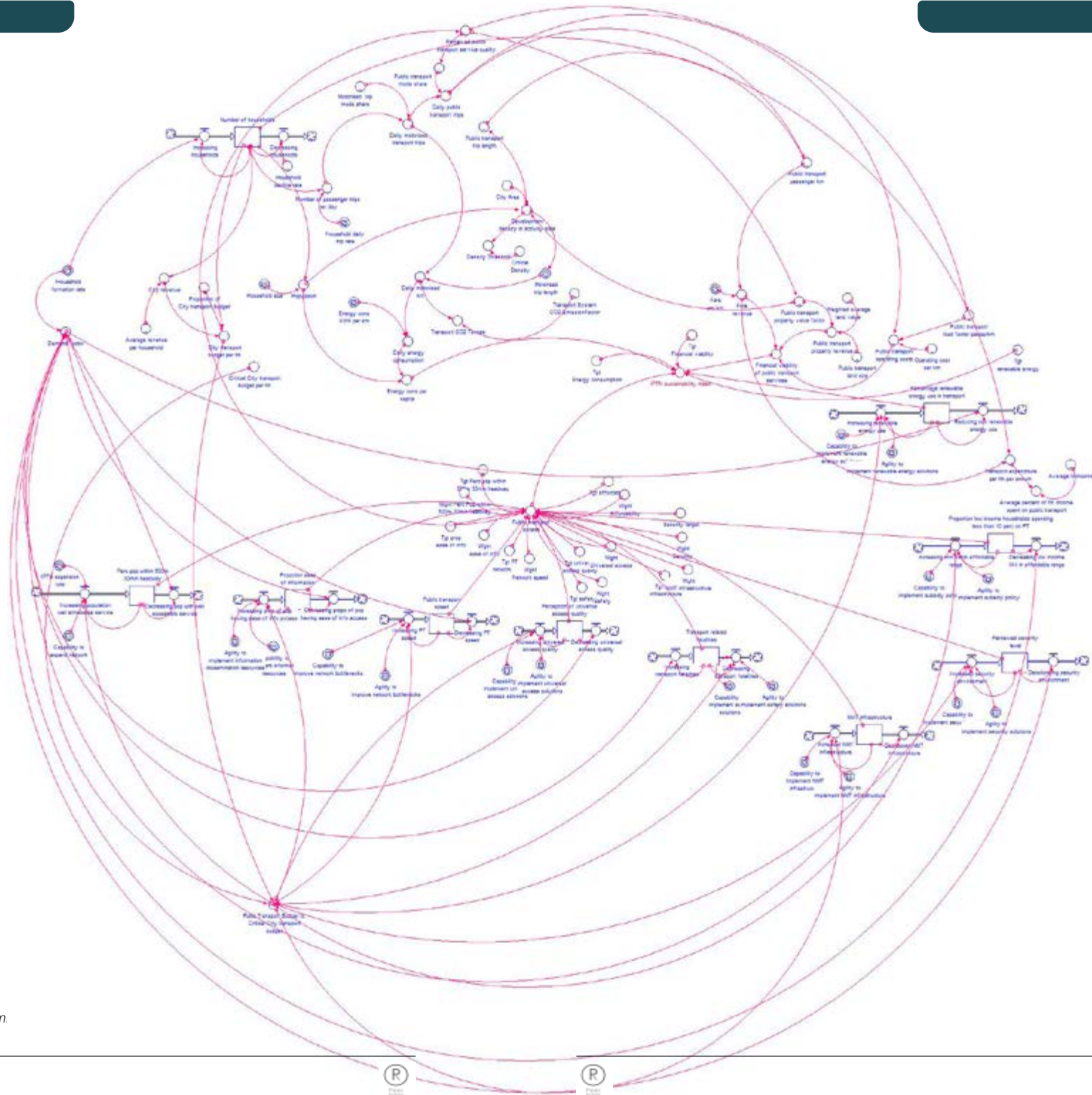


Figure 2: Systems dynam.

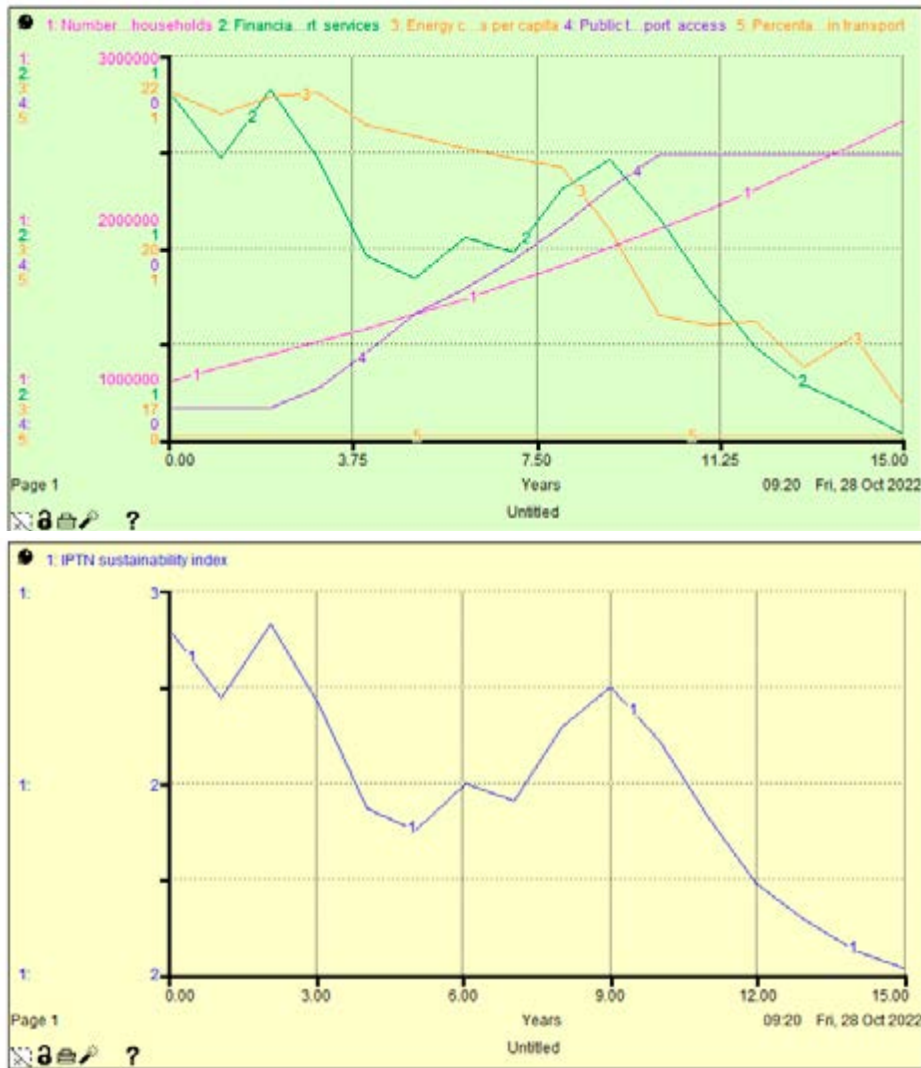


Figure 3: Baseline model outputs

working that do not improve relative to the baseline, computationally represented by constant values in variables such as organisational agility, organisational capability, and resource allocation. In another scenario evaluation, depicted in Figure 4, where the agility and capability to expand the IPTN for improved access, some marginal gain is realised relative to the baseline scenario. Typically, cities tend to expanding the network in isolation of other interventions

(fragmentary approach). While this does stabilise the system somewhat, it does not result in a turnaround. Turning around the trajectory requires a city to explore multiple interventions, while observing potential effects of the interventions, and unintended consequences of choices, on the system. In this way the model becomes a tool to facilitate conversations among stakeholders with interest in the outcomes.

- The two research questions are answered as follows:
1. To what extent does systems dynamics modelling platform offer a better alternative to established transport planning tools about spatial transformation, if any?
 - The building of a systems dynamics model is essentially a result of conversations among key role

- players. Therefore, a systems dynamics model tends to improve active participation of the role players.
- A systems dynamics modelling can take incorporate both quantitative and qualitative variables of interest in the model.
 - Feedback loops ensure that unintended consequences are accounted for in the modelling process.

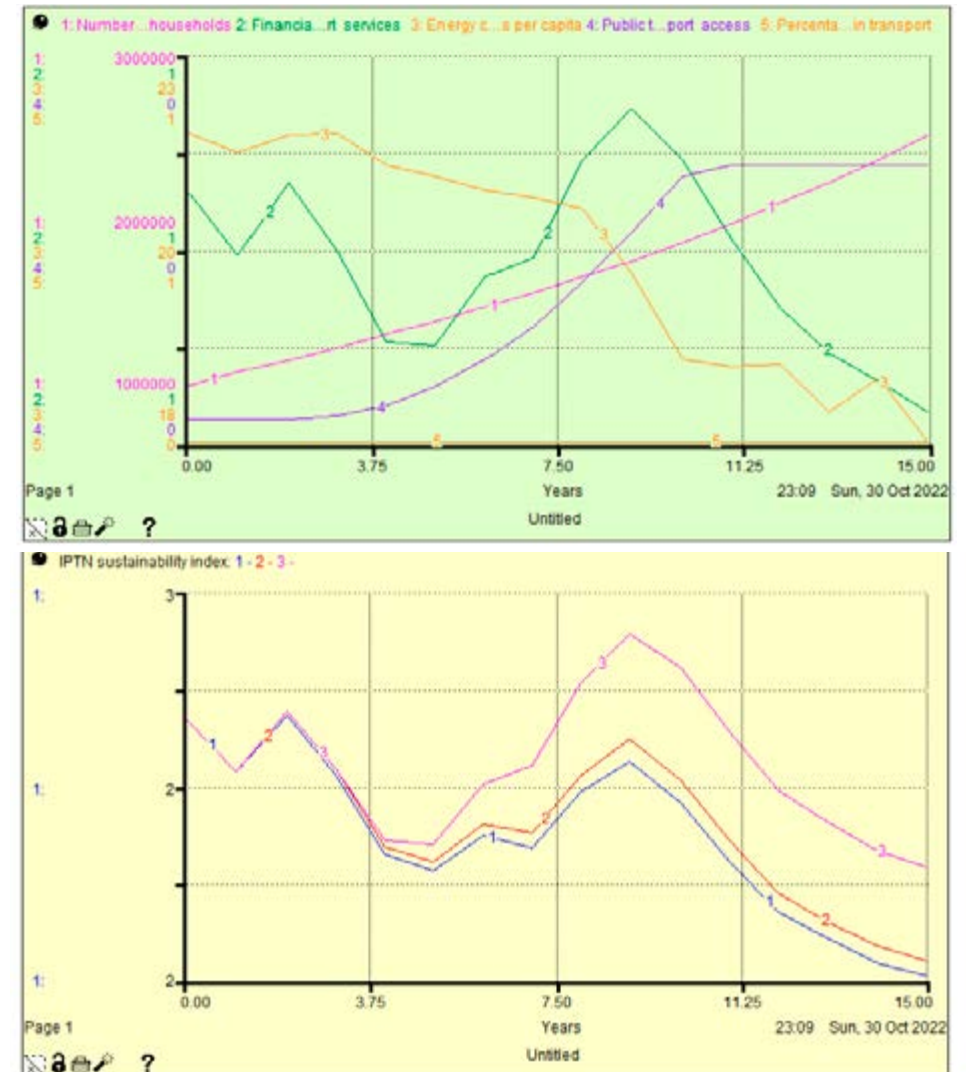


Figure 4: Profile following changing of selected variables

- The ability to model the system retrospectively allows for improved model validation.

2. What methodological weaknesses should be overcome by systems dynamics framework for wider adoption in spatial transformation modelling?

- Causal loop diagrams and the resulting models can be cumbersome to represent, to the extent that they may be seen as complicated by those who did not participate in the model building process.
- In many instances, the absence of empirical evidence to depict reference behaviour results may result in too many scenario variables within the model, and in turn render the model susceptible to many unknowns.

Conclusions

It is possible and desirable to use systems dynamics modelling to represent the behaviour of a city's transport system. Systems dynamics also lends itself well for modelling complex subjects such as spatial transformation.

Turning around the transport system to contribute positively to sustainable outcomes is an undertaking that requires cities to implement multiple, well-coordinated interventions and becoming more cognisant of unintended consequences. Therefore, systems dynamics modelling should form an integral part of development planning in cities. However, implementing a systems dynamics model in a city requires considerable investment in research to enable model calibration and validation.

A systems dynamics model should be used to facilitate conversations among role players as opposed

to being used as a predictive tool. Ideally, role players making use of the results should be involved in the model building process to minimise alienation from what could be considered complicated model representations in the form of spider-web type diagrams.

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MINING



Sustainable Mining

Dionne Kerr: CEO, Siyakha Consulting

The dictionary definition of sustainability includes reference to meeting the needs of current generations without negative impact on the needs of future generations. The achievement of balance between economic growth, environmental care and social well-being.

However, in parallel to this, the word “sustainable” also refers to the ability to be able to continue over a period of time.

The question we have to ask is whether the opportunity exists for mines to be sustainable, whilst still achieving the ever-increasing demand for sustainability. If we are to achieve our sustainability goals, it is important to have strategic intent. By this, I mean that goals should move away from compliance and an opportunistic form of mitigating external risk, towards a more strategic focus on organisational purpose.

Many companies today submit ESG reports annually which track impact across their various sites and operations, and, in their dialogue and market positioning, they prioritise doing the “right” thing and have a strong operating ethos. Reporting in South Africa is relatively strong, because of the Transformation legislation and Mining Charter license criteria for reporting, the increasing demand by funders and the JSE reporting requirements.

However, the information in these reports is not necessarily an accurate reflection of the current state and there is not necessarily alignment to

what the organisation seeks to, and commits to, strategically achieve.

Our work in conducting social audits tells us that the discrepancy between Municipal information and the mine’s information is vast. The difference between the mines’ information and the actual reality on the ground is just as wide, in many circumstances. This is why DMRE asked for social audits to be conducted for the SLP approval process. So that our plans consider the needs of the communities we seek to empower through the legislation that is supposed to protect mining communities.

The lack of scenario planning means there is no mechanism to check what impact future strategic, compliance, or external factors may challenge their trajectory. Reporting may need to be adjusted to consider and track these factors to ensure that sustainability can be authentically achieved.

In recent days we have seen the announcement of a US achievement of nuclear fusion. Whilst a way away from being fit for purpose for industrial use, there is progress. Wits University announcing that they have found a solution for Acid Mine Draining which not only cleans the water, but extracts the precious minerals for further processing.

In parallel to this, the Mining Charter III, suggest we should localize procurement and monitor local content.

We should include mine communities in ownership structures and employ, buy and support local-to-site initiatives.

All of these issues push us towards a way of working in the future, not only in mining, where we consider that commercial returns may well be enhanced because of our focus on environmental and social issues, and not despite the cost and administration of same. It can be argued that if your sustainability strategy doesn’t align to your commercial strategy, or realise commercial returns, then it may be the wrong strategy.

We developed a model for Mine Closure and Mine Community Development in 2016 which we had the opportunity to test in a feasibility study, to look at Mine Closure using a circular economy model to achieve long-term community sustainability post mine-closure.

The exercise confirmed our assumptions that, by and large, there lacked strategic understanding of the opportunity that exists to start planning for mine closure at the commencement of mine operations.

A real and meaningful commercial argument can be built around the return on investment from addressing environmental, social and economic diversification needs in the planning phase of mine operations.

So often “community development” is seen as a “soft touch” opportunity to mitigate labour unrest and ensure reduction of risk in interruptions in production.

The compliance factors of mining license, water management and mine rehabilitation are largely seen through the lens of compliance and risk and the focus on B-BBEE compliance is mostly an annoyance, as opposed to an ethos for inclusion.

At yet, the strategy team talk about the juncture we are at, where the mine of the future meets current practice. Automation, mining performance through enhanced technology and data analytics and mechanisation. Recognition that a mine holds significant land, people, water and waste assets that could be valuable, and finally, that sustainability could be a catalyst to these changes.

The introduction of solutions in these areas, will impact their operating expenses and pass through to their margins, legitimacy, risk mitigation, value and ensure that they are commercially sustainable, while sustainability is deeply considered.

Allegations of “greenwashing” and lack of legitimacy of reporting information abound. This shows us that we have not yet reached the point of maturity where it holds a business rationale and our leadership are not yet authentic in their understanding of how important it is to understand that businesses of the future will operate differently. It’s time to consider what this means.

In South Africa, this could mean water solutions, solar infrastructure that extends to the communities’ needs, “manufacture” of soil to address soil erosion legitimately, innovation in water technology, re-skilling mine workers into the processing plants to produce South African technology and engineers to automate mine operations, drone manufacture and skills development for mine security and agricultural excellence that reduces chemicals and water over-utilisation, recycling, innovation, technology, energy crops, food security, the list goes on.

Our Feasibility showed that if we apply the principles of Just Transition, DMRE’s mining charter requirements, the global push for Sustainability and eradicating the impact of “dirty” industries, then, in fact a mine is a closed circular economy that can not only create, but self-repair environmental damage whilst still retaining the impact on localised opportunities for job creation and mine community development.

If we don’t get the ethos right and embed an understanding of how “differently” organisations need to operate, then ultimately it matters not whether it is mining or renewables, we will be unsustainable for as long as we do not prioritise sustainability.

Are we there yet? The neverending fight for gender equality and the long road that remains ahead - a snapshot of what the statistics reveal

Shannon Manuel



To say that significant strides haven't been made in achieving gender equality would be a disservice to those who have put in tremendous work over the years. But the path towards sustainable and global gender equality remains lined with challenges and unheard voices.

In 2005, the adoption by 189 governments of the Beijing Declaration and Platform for Action marked a turning point in the history of women's rights. This progressive blueprint remains a powerful source of inspiration in the effort to realize equal opportunities for women and girls.

However, while much progress has been made in the intervening decades, much more remains to be done to ensure that women and children are guaranteed healthy lives, education, and full social inclusion.

Gender equality and women's empowerment are an integral part of the 17 Sustainable Development Goals (SDGs) - implemented in 2015, to be achieved by 2030. Achieving the full guarantee of women's and girls' rights through all these goals and their targets is the only way to work towards the consolidation of more responsible, just, and egalitarian societies. This aims to achieve inclusive economies that guarantee equal opportunities and that benefit all people, and protect the environment, now and in the future.

Seeking to fulfill the promise of leaving no one behind, the 2030 Agenda for Sustainable Development charts a path to realizing human rights for all. Closing gaps between men and women is a catalytic element for sustainable development and the deepening of democracies. To this end, all the SDGs have included gender equality as a cross-cutting element to guaranteeing women's rights.

While this cross-cutting approach runs throughout the Agenda, Sustainable Development Goal 5 is specifically dedicated to accelerating progress toward closing the gender gap, ending all forms of discrimination against women and girls worldwide, and achieving gender equality.

Goal 5 Targets

1. End all forms of discrimination against all women and girls everywhere

2. Eliminate all forms of violence against all women and girls in the public and private spheres, including trafficking and sexual and other types of exploitation
3. Eliminate all harmful practices, such as child, early and forced marriage and female genital mutilation
4. Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate
5. Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision making in political, economic and public life
6. Ensure universal access to sexual and reproductive health and reproductive rights as agreed in accordance with the Programme of Action of the International Conference on Population and Development and the Beijing Platform for Action and the outcome documents of their review conferences

- Undertake reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources, in accordance with national laws
- Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women
- Adopt and strengthen sound policies and enforceable legislation for the promotion of gender equality and the empowerment of all women and girls at all levels.

Progress report

The latest available Sustainable Development Goal (SDG) 5 data show that the world is not on track to achieve gender equality by 2030.

COVID-19 and the backlash against women's sexual and reproductive health and rights are further diminishing the outlook for gender equality. Violence against women remains high; global health, climate, and humanitarian crises have further increased risks of violence, especially for the most vulnerable women and girls; and women feel more unsafe than they did before the pandemic. Women's representation

in positions of power and decision-making remains below parity. Only 47 per cent of data required to track progress on SDG 5 are currently available, rendering women and girls effectively invisible.

"Progress on the Sustainable Development Goals: The gender snapshot 2022" presents the latest evidence on gender equality across all 17 Goals, calling out the long road ahead to achieve gender equality. It emphasizes the interlinkages among the goals, the pivotal force gender equality plays in driving progress across the SDGs, and women and girls' central role in leading the way forward.

The statistics revealed that:

- Globally, over 380 million women and girls are in extreme poverty, living on less than \$1.90 a day. If current trends continue, in sub-Saharan Africa, more women and girls will live in extreme poverty by 2030 than they do today.
- Globally, nearly 1 in 3 women experienced moderate or severe food insecurity in 2021. Rising food prices are likely to exacerbate hunger around the world.
- Unsafe abortion is a leading but preventable cause of maternal mortality and morbidity. Today, over 1.2 billion women and girls of reproductive age live in countries and areas with some restrictions on access to safe abortion. 102 million live in places where abortion is prohibited altogether.
- Protracted conflicts, wars and renewed efforts to keep girls out of school perpetuate gender gaps in access to school and learning. 54% of GIRLS who are not in formal education worldwide live in crisis affected countries.
- At the current rate of progress, it may take another 286 years to remove discriminatory laws and close prevailing gaps in legal protections for women and girls. Globally, more than 1 in every 10 women and girls aged 15-49 were subjected to sexual and/or physical violence by an intimate partner in the previous year. In 2021, 4,475 communities made public declarations committing to eliminate female genital mutilation. Women hold over one third of seats in local decision making bodies.
- School and day-care closures in 2020 led to an estimated 512 billion additional hours of unpaid childcare globally for women. The glass ceiling remains intact. Close to 1 in every 3 managers/supervisors is a woman. At the current pace of



change, parity will not be achieved for another 140 years. Despite progress, only 26% of countries have a comprehensive system to track gender budget allocations.

- The lack of clean water claims the lives of more than 800,000 women and girls every year.
- Affordable and clean energy, key to lifesaving care and productivity, remains out of reach for millions of women and girls in Asia and sub-Saharan Africa. Rising energy prices are making matters worse.
- Women's labour force participation in 2022 is projected to remain below pre pandemic levels in 169 countries and areas.
- Women hold only 2 in every 10 science, engineering and information and communication technology jobs globally. They comprise only 16.5% of inventors associated with a patent.

- By the end of 2021, some 44 million women and girls had been forced to flee their homes due to climate change, war, conflict and human rights violations.
- The majority of the world's women live in cities. 49% of women in urban areas report feeling less safe walking alone at night since COVID-19 began.
- On average, one disaster resulting in 115 deaths and losses of \$202 million was recorded daily during 1970-2019. Women, especially from poor and marginalized communities, are disproportionately affected.
- Strong institutions that support just and peaceful societies are not possible without women. But women globally hold just 42% of judicial positions and make up a tiny share of police forces - a mere 16%.
- Funding for gender equality is not keeping pace with the increasing severity of global challenges and backlash against women's rights. Just 4.6% of bilateral allocable ODA goes to programmes where gender equality is the main objective.

Attitudes towards gender

Even though 'sustainability' has become a key concept guiding global, national and local institutional frameworks, policies and interventions, the concept is ever-changing and deeply debated and contested.

Gender has been variously ignored by, or incorporated into, conceptualisations and policy debates in a diversity of ways. A brief review highlights the historical roots of some key concepts and approaches that continue to co-exist and compete today, albeit in contemporary forms.

Drawing together a chronology of environmental policies and action with evolving feminist perspectives on these, we chronicle - albeit in outline - a rich history of work on gender, environment and sustainable development over the last 30 years, with feminist theory co-evolving with feminist movements. Many of these approaches offer vital insights, principles and ways to enrich our gendered pathways approach, offering valuable potential for the design of policies and interventions and fostering a progressive politics of sustainability and gender equality. Yet, other conceptualisations are problematic and when applied in practice - including those mobilized as narratives by feminist policy makers at particular policy moments - have

worked against gender equality and sometimes sustainability too. For each sub-section, we highlight positive contributions and insights, drawbacks and dangers in theory or when translated into policy, projects or practice as well as potential aspects to take forward into a gendered pathways approach.

The Levers of Change: Gender Equality Attitudes Study 2022, is the latest iteration of a bi-annual global study that tracks attitudes towards gender. The study, developed under the leadership of UN Women in partnership with Johnson & Johnson, Kantar, Procter & Gamble and Unilever, examines perceptions across a multitude of areas including leadership and political participation, education, healthcare, the workplace, media representation, marriage and family life, safety and violence, and control over personal decisions. The 20-country-wide survey reveals some areas of improvement yet findings demonstrate that discriminatory social norms continue to stifle progress.

Respondents in South Africa believe it is easier for most men than for most women to access quality education and health care, be hired as skilled workers, run for elected office, buy property in their name, and have control over personal finances and decisions in their lives.

At the same time, most respondents (89%) agree that women should be free to make choices regarding marriage - if, when and whom they marry - and 91% believe it is essential for women to have access to family planning. Although 92% of respondents see women's access to university education as key to the country's future success, 33% agree that it is more important for a boy to get a university education than a girl.

Most respondents (86%) believe it is essential for society to treat women as equal to men and 82% agree that a woman should be free to refuse sex with her husband/partner. Yet 33% also think there are acceptable circumstances for someone to hit their spouse or partner. In addition, 34% of respondents perceive that most women feel unsafe in their home, and 41% perceive that most women feel unsafe in public spaces.

Roughly 3 in 4 respondents believe that both women and men are typically portrayed by the media in traditional roles. Nearly half (46%) agree that women call attention to themselves based on

how they dress, and 37% believe it is appropriate for men to discuss a female colleague's appearance at work.

Interestingly, although 44% believe that a man's job is to earn money while a woman's job is to look after the house and the family, and half of respondents agree that women should work less and devote more time to caring for their family, 1 respondent in 3 agrees that children suffer just as much when the mother and the father work for pay. Conversely, 1 in 3 also believes that men should be paid more than women for the same job, and that a woman should not earn more than her husband.

Respondents in South Africa ascribe high importance to gender equality in all areas for their

country's future success. Yet 42% of respondents believe that when jobs are scarce, men should have more right to a job than women and that men should be given priority in times of food shortages.

No country has achieved the promise of gender equality envisioned in the SDGs, reveals The 2022 SDG Gender Index.

Not one of the 144 countries in the Index has fully achieved the promise of gender equality envisioned in the SDGs (Figure 5), and not even the top-scoring countries are on track to hit the targets for every goal and indicator.

Trends in global gender equality: progress, but too slow and patchy. More than half of countries

TABLE 1

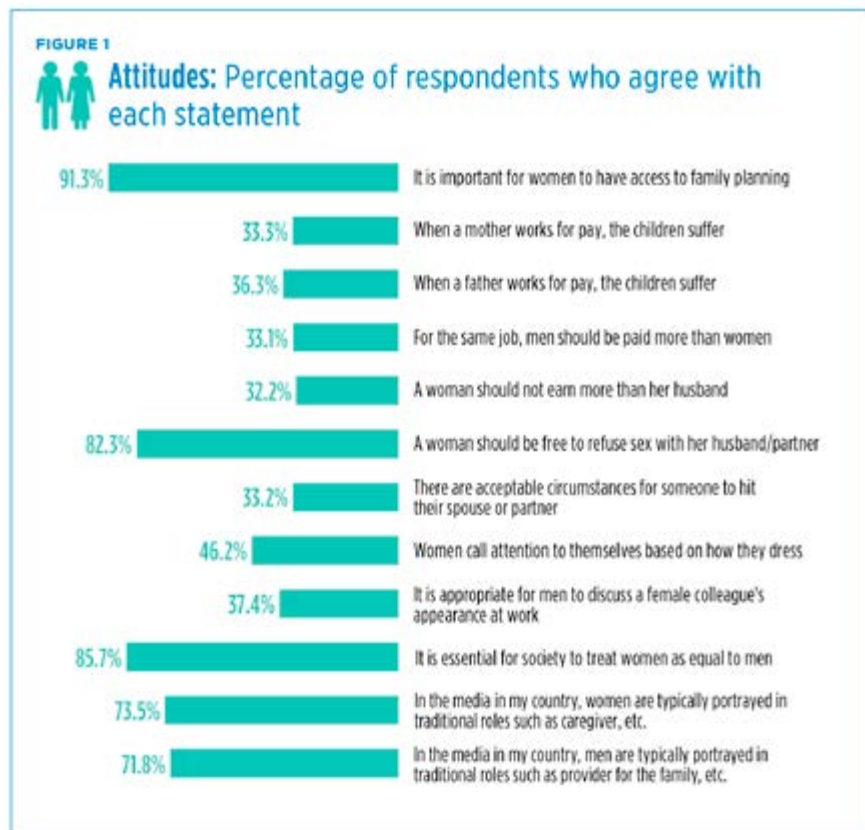
Perceptions: Percentage of respondents who agree with the statement

	% FOR MOST WOMEN	% FOR MOST MEN
In general, it is easy for most women/most men to get a quality education	61.4	63.4
In general, it is easy for most women/most men to be hired as skilled workers	36.9	50.6
In general, it is easy for most women/most men to run for elected office	36.4	60.5
In general, it is easy for women/men to buy property in their own name	49.7	63.6
In general, most women/men have control over their decision on who to marry	55.6	70.5
In general, most women/most men have control over their lives	55.3	73.2
In general, most women /most men have control over their personal finances	59.3	67.4

TABLE 2

Perceptions: Percentage of respondents who agree with each statement

	% POOR/ UNSAFE	% ADEQUATE
In general, the quality of basic health care for women is ...	16.7	34.7
In general, the quality of basic health care for men is ...	17.8	35.8
In general, the quality of basic health care for you is ...	16.4	31.5
The quality of family planning services is ...	16.4	32.9
In general, do most women feel safe when they are in their home (by safe, we mean "free from physical, mental, or emotional harm")?	33.6	31.6
In general, do most women feel safe when they are in public spaces (by safe, we mean "free from physical, mental, or emotional harm")?	41.3	27.9



worldwide – 91 out of the 135 with comparable data – made progress on gender equality since 2015: 28 countries (21 per cent) made ‘fast progress’; while 63 (47 per cent) countries made ‘some progress.’

However, even for these countries that made progress, the improvement in Index scores was, in general, quite small (an average improvement of around 3 points out of 100). A significant proportion of countries (around 1 in 3 countries, or 32.6 per cent) either made no progress at all or moved in the wrong direction since 2015.

The six countries that moved in the wrong direction on gender equality to a noticeable extent (with their scores dropping more than 1 point between 2015 and 2020) were Venezuela (-6.7 points), Afghanistan (-1.7 points), Algeria (-1.3

points), Belarus (-1.3 points), Kuwait (-1.3 points), and Ecuador (-1.1). There are countries that made relatively large leaps on a range of gender equality issues between 2015 and 2020.

The 10 countries that saw the greatest improvements in their Index score were Benin (+9.3 points), Saudi Arabia (+8.6 points), Armenia (+6.7 points), Nepal (+6.7 points), Egypt (+5.8 points), Moldova (+5.1 points), Iraq (+5.0 points), Tajikistan (+5.0 points), United Arab Emirates (UAE) (+5.0 points), and Senegal (+4.8 points). For a further breakdown of the goals and issues that drove these countries’ relatively fast progress, see Annex 4. While significant gender equality challenges remain, this group of ten fast-moving countries have made noticeable strides on a range of gender equality issues in just a few years.

With the exceptions of Saudi Arabia and the UAE (which are both high-income countries), the other fast-moving countries in this list are middle-income countries. While each of them still needs to make further progress on gender equality (the average Index score across this group of ten fast-moving countries was ‘very poor’, at just 58 out of 100), it is encouraging to see that some countries are at least going in the right direction and at a relatively rapid pace.

Overview of the policy recommendations

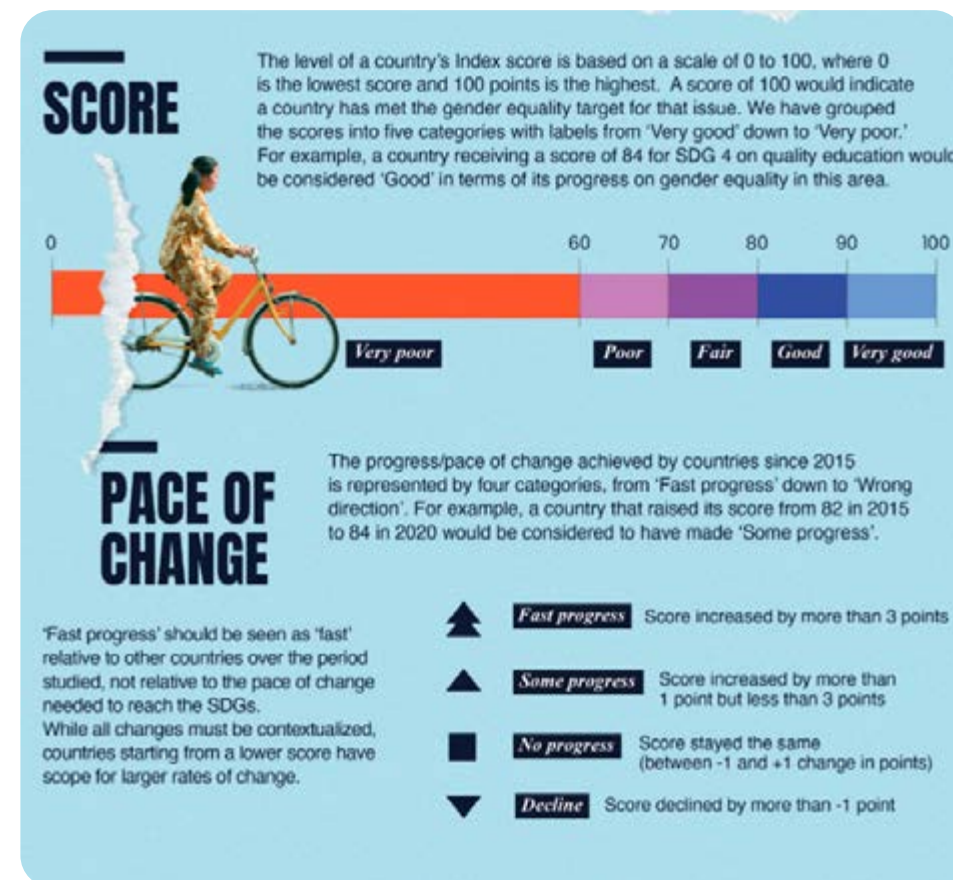
The 2022 SDG Gender Index sets out a blueprint for change, based on six cross-cutting themes that often characterize the countries and regions making some progress on gender equality.

• Reform and apply inequality laws

Countries that reform and fully implement gender equality laws have better health, nutrition and educational outcomes for women and their families, more resilient employment for women, and more women in their parliaments.

• Invest in public services and social (including care) infrastructure

The social transformation needed for gender equality must be funded, which requires gender-responsive budgets, progressive taxation and strong investment in public services and public (including care) infrastructure.



Rank	Country	Score	Change in points	Rank	Country	Score	Change in points	Rank	Country	Score	Change in points
1	Denmark	95.4	▲ 1.0	51	North Macedonia	72.5	▲ 1.3	101	Cambodia	60.5	▲ 4.7
2	Sweden	90.3	■ 0.1	52	Moldova	72.4	▲ 5.1	102	Botswana	60.3	■ 0.9
3	Norway	89.2	▲ 1.6	53	Belarus	72.3	▼ -1.3	103	Ghana	59.9	▲ 3.8
4	Iceland	89.0	■ 0.1	54	Kazakhstan	72.0	■ 0.8	104	Iran	58.7	■ 0.7
5	Finland	88.9	■ 0.8	55	Trinidad & Tobago	71.4	▲ 1.7	105	Lebanon	58.2	■ 0.1
6	Austria	88.7	▲ 1.9	56	South Africa	70.9	▲ 1.6	106	Myanmar	57.7	-
7	Netherlands	88.3	■ 0.6	57	Bosnia & Herzegovina	70.7	▲ 2.9	107	Bangladesh	57.7	▲ 2.7
8	Switzerland	87.8	▲ 0.8	58	Mongolia	70.6	▲ 4.3	108	Rwanda	57.3	▲ 1.4
9	Luxembourg	86.7	■ 0.2	59	Malaysia	70.3	▲ 3.6	109	Lesotho	57.1	▲ 1.6
10	Ireland	86.5	▲ 2.9	60	Thailand	70.1	▲ 1.8	110	Kenya	56.3	▲ 1.1
11	New Zealand	85.3	▲ 1.4	61	Philippines	69.8	▲ 1.1	111	Venezuela	55.8	▼ -5.7
12	Spain	84.8	▲ 2.5	62	China	69.7	▲ 2.0	112	Tanzania	55.7	▲ 4.4
13	Belgium	84.7	■ -0.4	63	Uzbekistan	69.4	■ 0.6	113	Senegal	55.2	▲ 4.8
14	Australia	84.7	■ 1.0	64	Viet Nam	69.4	▲ 2.2	114	Mozambique	54.6	▲ 2.8
15	Estonia	84.3	■ 1.0	65	Ukraine	69.3	▲ 3.4	115	Gabon	54.5	-
16	Canada	84.2	▲ 1.9	66	Panama	69.2	▲ 2.1	116	Eswatini	54.2	-
17	France	83.8	▲ 2.2	67	Mexico	69.0	■ 0.2	117	Berlin	53.7	▲ 9.3
18	United Kingdom	83.7	■ -0.8	68	Kyrgyzstan	68.7	■ -0.7	118	Gambia	53.5	▲ 3.9
19	Slovenia	83.4	■ -0.8	69	Ecuador	68.7	▼ -1.1	119	Cameroon	53.1	■ 0.9
20	Singapore	83.0	▲ 2.8	70	Qatar	68.5	-	120	Zimbabwe	53.0	■ -0.8
21	Germany	83.0	■ 0.7	71	Russia	67.8	▲ 3.6	121	Côte d'Ivoire	51.7	▲ 3.6
22	Czechia	82.6	▲ 1.9	72	Morocco	67.7	▲ 2.7	122	Iraq	51.2	▲ 5.0
23	Portugal	82.5	▲ 2.6	73	Dominican Rep.	67.6	▲ 1.5	123	Pakistan	50.6	▲ 2.1
24	Lithuania	81.3	■ 0.9	74	Paraguay	67.5	▲ 1.8	124	Zambia	50.4	▲ 1.7
25	Israel	81.3	▲ 3.1	75	Colombia	66.8	■ -0.1	125	Ethiopia	49.8	▲ 1.3
26	Latvia	80.4	■ 0.7	76	Indonesia	66.7	▲ 1.8	126	Burkina Faso	49.4	▲ 3.2
27	Cyprus	80.2	▲ 2.8	77	Turkey	66.5	■ -0.4	127	Togo	49.2	▲ 2.5
28	Croatia	79.7	▲ 2.7	78	Brazil	66.4	■ -0.8	128	Angola	49.2	-
29	Malta	79.3	▲ 1.9	79	Peru	66.2	▲ 1.6	129	Uganda	49.0	■ 0.2
30	Slovakia	79.0	▲ 1.6	80	Jordan	66.2	▲ 2.1	130	Nigeria	48.4	■ -0.7
31	Uruguay	78.7	▲ 2.8	81	Jamaica	66.1	■ 0.7	131	Malawi	48.0	■ 0.8
32	Italy	78.0	▲ 1.6	82	Tajikistan	66.0	▲ 5.0	132	Liberia	47.7	▲ 3.4
33	Hungary	77.9	▲ 2.1	83	Tunisia	65.9	▲ 2.0	133	Mali	47.6	▲ 3.5
34	Poland	77.7	■ 1.0	84	Belize	65.6	-	134	Madagascar	47.3	▲ 2.6
35	Japan	77.5	■ 0.8	85	Oman	65.6	-	135	Mauritania	46.0	■ -0.7
36	South Korea	76.9	▲ 2.8	86	Sri Lanka	65.5	▲ 1.5	136	Sierra Leone	44.4	▲ 1.9
37	Greece	76.7	■ 0.3	87	Azerbaijan	65.5	■ 1.0	137	Guinea	44.3	▲ 2.4
38	United States	76.6	▲ 2.2	88	Nicaragua	65.1	■ -0.1	138	Burundi	43.6	▲ 1.9
39	Serbia	76.6	▲ 4.0	89	Kuwait	64.9	▼ -1.3	139	DR Congo	43.3	▲ 4.0
40	Montenegro	76.5	▲ 1.6	90	El Salvador	64.6	▲ 2.6	140	Niger	43.3	▲ 2.8
41	Costa Rica	76.3	▲ 1.5	91	India	64.5	▲ 4.1	141	Sudan	43.1	-
42	United Arab Emirates	76.2	▲ 5.2	92	Saudi Arabia	64.4	▲ 8.6	142	Yemen	39.3	-
43	Mauritius	75.3	▲ 1.6	93	Algeria	64.3	▼ -1.3	143	Afghanistan	38.2	▼ -1.9
44	Argentina	74.5	■ -0.8	94	Nepal	64.2	▲ 6.7	144	Chad	35.6	■ 0.7
45	Armenia	74.3	▲ 6.7	95	Bolivia	63.2	■ 0.1				
46	Albania	74.2	▲ 3.6	96	Egypt	62.4	▲ 5.8				
47	Bulgaria	74.0	■ 0.2	97	Laos PDR	61.2	▲ 2.3				
48	Georgia	73.4	▲ 4.7	98	Guatemala	61.2	▲ 1.4				
49	Chile	73.3	▲ 1.2	99	Honduras	61.0	▲ 2.8				
50	Romania	72.8	■ 1.3	100	Namibia	60.7	■ 0.6				

Source : 2022 SDG Gender Index, Equal Measures 2030.

Promote the leadership, participation and voice of girls and women

The key is to combat gender norms and promote role models, with the greater visibility of women in public life creating a virtuous circle of participation.

Close the gender data gaps

This means investing in improving data infrastructure and formalizing the idea of a gender data ecosystem, but also mobilizing and building bridges between different stakeholders and data communities, and making good use of 'big data'.

Invest in, create space for, and listen to feminist organizations and movements

Little progress on women's rights would have been made without pressure and advocacy from these organizations and movements. They need proper resourcing and safe, secure spaces in which to operate and advocate.

Work with and empower girls and young women

Their voices should be heard in the decisions that affect them. Programmes, policies and laws designed with and for them, and funding for their groups, are critical for accelerated progress towards gender equality.

The challenges of building pathways to sustainability and enhancing gender equality are both urgent. Around many issues – whether work and industrial production, population and reproduction, food and

agriculture, or water, sanitation and energy – dominant development pathways have proved both unsustainable and gender unequal. Both economic, social and environmental unsustainability and gender inequality are produced by, and yet threaten to undermine, market-focused, neo-liberal patterns of growth. As troubling intersections of unsustainability and gender inequality create environmental pressures around climate change, biodiversity and pollution, so shocks, stresses and feedback may undermine gendered rights and capabilities even further. But the reverse is also possible: gender equality and sustainability can powerfully reinforce each other in alternative pathways.

Integrating gender equality with sustainable development requires profound conceptual understanding of both concepts and their interlinkages. The twin challenges of building pathways to sustainable development and enhancing gender equality have never been more pressing.

With less than a decade to fulfill the 2030 Agenda for Sustainable Development, gender equality is fundamental to delivering on the promises of sustainability, peace, and human progress. How far have we come in turning the 2030 Agenda into results for women and girls, how has COVID-19 set us back and what is needed to bridge the remaining gaps between rhetoric and reality?

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YOUTH



Building sustainable brands and careers with YES

The Youth Employment Service (YES) is a private sector programme which affects broad-based change across industries, provinces and the country. As a business-led initiative, we address the country's youth unemployment crisis by empowering businesses to create jobs for our unemployed youth. In return, businesses receive up to two levels on their B-BBEE scorecard and/or integrate into environmental, social and governance (ESG) strategies.

What is a sustainable brand?

For YES, a sustainable brand is focused on leaving a meaningful legacy that is true to our country's potential, and includes a keen focus on the following:

1. Our environment

More efforts at conservation and green energy/business practices will result in better sustained environments for the future – not only so our children will see a real-life rhino in the future, but so that we can economically

benefit from our sprawling beaches, mountains, and parks through domestic and international tourism.

2. Our country's systems and institutions

The need to rebuild working structures for many of our systems in critical sectors like healthcare, education, early childhood development, and our general administration continues to rise. The health of our nation mentally and physically, as well as the safety and nurturing of our children and elderly will lead to a more prosperous and equal society.

3. Inheritance

Investment in relevant and future-facing industries, i.e., digital, finance, mining, global business services, care, creative, agri and more will ensure that our youth inherit skills that will catapult their careers, leapfrog critical SA industries, and enable us to create more opportunities.

4. Ethical practices

It is critical to cultivate a legacy that reflects a culture of ethical practice. This will contribute towards erasing poverty, unemployment, complicity, mediocrity and a tradition of inaction or worse – complicity.

But who will buy from our sustainable brands?

Our youth unemployment statistics are at a crisis point. Two thirds of youth between 15-34 are unemployed. That's 7.3 million young South Africans who are not contributing to the fiscus and putting pressure on our social grant's system, taxpayers, and society. If youth aren't earning, they can't buy from your business now, and in the future. Ensuring youth get experience and the opportunity to earn ensures the building and shaping of your consumer base, who will then have the purchasing power to support your company in the future.

Rebuilding sustainable and inclusive brands

The importance of ESG strategies and the United Nations' Sustainable Development Goals (SDGs) has seen a rise over the past eight to ten years. Investors and consumers world-wide have intentionally used these strategies to determine whether or not they will utilise their resources to endorse brands, services, and products.

Your organisation's social and environmental impact is beginning to determine how it stands up

next to its competitors. Investors and consumers are beginning to align their buying power based on your business practices. More and more, they want to see business practices that are inclusive of people and planet. This means you have to make decisions that, for example, prioritise environmental sustenance, bridge the gender gap, and/or capacitate undervalued demographics into the labour force, to name a few.

YES jobs can seamlessly integrate into your business' ESG/SDG strategies, helping your organisation increase impact in spaces where it's needed most and that mean the most to your organisation.

The YES turnkey solution: it is more than just jobs

Should your company not be able to host youth inside your organisation, you have the option to place youth with a one of YES's vetted host partners. YES works with host partners who are generally non-profits and small businesses working in high-impact sectors where youth live, which means they do not have to travel far for work and can play an important part in building their own communities.

These high-impact sectors include conservation, healthcare, education, early childhood development as well as future-facing sectors that have the capacity for high absorption, such as agri, global business services (GBS), tech and digital, and more.

The YES multiplier effect

By placing youth in roles that will upskill them, encourage greater levels of entrepreneurship, and/or forge longstanding career-paths, we are creating a multiplier effect; where one job can create ten or more.

Answering questions for the forward-thinkers who want to create an impact:

1. What are some sustainable career options for the youth I want to place through YES?

Every sector in South Africa's economy is important – and any company from any industry can place youth through YES.

Through both the internal and external models (the turnkey solution), YES Youth are being placed in sectors which are key economic and social contributors, such as healthcare, financial services,

retail, education, early childhood development, eco-tourism and hospitality, and conservation.

More than this, YES and our partners actively seek to create jobs in 'sunrise' or future-facing industries that will prepare youth for the future world of work, sustain their careers, and put SA at the top of global industry rankings.

These sectors include digital and tech, agriculture, processing and urban farming, global business services, green energy, mining, creative and drones.

2. What is the impact of these sustainable careers on country and economy?

Economic growth is dependent on the workforce, its skills, productivity and its ability to buy and sell goods and services. Sustainable careers grounded in relevant skills and in-demand goods and services bring long-term security for youth, the labour force, and the economy. This will have a dynamic impact on country and economy as both begin to function adequately to absorb workers and support the circulation of money.

Further, research shows that investing in economically vulnerable groups such as young women results in an increase of business productivity and skills, creating jobs that will in-turn create more jobs.

3. What do we do now to ensure we are future-ready?

It is vital that South Africa provides young people with the education, skills and experience needed to

thrive as active economic participants. Skills and experience, particularly the latter, is what YES and its corporate partners specialise in.

[Register with YES today](#)

Your investment in our SA youth pays off

Delisile Mntambo was transformed from an unemployed youth from KwaNgcolosi, KwaZulu-Natal into a business owner powerhouse.

"On 16 May 2021, after receiving my first YES salary, I started an agribusiness on the side called Thandokuhle Poverty Fighters and planted approximately 4,000 cabbages. Due to the high rate of unemployment in my village, the majority of children depend on the feeding scheme at schools for their main meal and often go to bed hungry, which is not enough for active and growing minds.

Today, my business focuses on quick growing crops for consumer consumption. I am very grateful for the opportunity and the work readiness training received from the YES programme," says Delisiwe.

Delisile's crop of 4,000 cabbages soon expanded to green peppers, lettuce, spinach and aubergines. She now supplies top retailers and supermarket chains, including Food Lover's Market and Jwayelani."

Join the movement of over 2,200 businesses signing on to create a future that works. Gain levels immediately. Change lives forever.

Build sustainable brands and careers with YES

Seamlessly integrate into impactful job creation and gain up to two levels on your B-BBEE scorecard immediately.

Join over 2,200 businesses creating 12-month work experiences for youth and co-create a future that works for all.

#SayYES



SUSTAINABILITY SUMMIT 2023

14 - 16 NOVEMBER 2023

SUSTAINABLE DEVELOPMENT - THE FUTURE WE NEED!

The 13th annual Sustainability Summit is going live!

The 2023 edition of the Summit will be held as a hybrid event – combining both the in-person and virtual experiences. Thus offering both exponential global reach and accessibility by easily bringing the content directly to the audience.

The world is collectively embracing the idea of a green recovery as a means to achieve sustainable, resilient, inclusive economic growth. Imagine a world of zero-carbon growth—where industry is water wise and energy efficient, where infrastructure is smart and inclusive, where waste is converted into lucrative revenue streams. Imagine an economy that takes care of business needs while securing the rights of future generations and offering women and youth the space they deserve.

With the effects of climate change biting down like never before, wide spread environmental and human health challenges at the municipal scale, and the desperate need for employment and economic development—one key, cross-cutting policy strategy has never been more urgent.

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