

Special Report 3

GEOPOLITICAL ENERGY FUTURES

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Navigating South Africa's Geopolitical Energy Transition by 2050

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African perspectives
Global insights

Executive summary

In the pursuit of climate-resilient, sustainable and equitable energy futures, the special report on 'Navigating South Africa's Geopolitical Energy Transition by 2050' presents a comprehensive exploration of the geopolitical energy landscape in South Africa. Delving into the intricate interplay of resource abundance, geopolitical dynamics and environmental imperatives, this report illuminates a path forward that balances economic development, geophysical limitations, limitations to growth and energy security with responsible resource management.

This special report is the third in a four-part series on the Geopolitical Energy Futures: Implications for South Africa. The series of special reports consists of:

Special Report 1

Global Markers in South Africa's Just Energy Transition

Special Report 2

The Geopolitics of Energy in the Post-COVID-19 Era

Special Report 3

Navigating South Africa's Geopolitical Energy Transition by 2050

Special Report 4

Systemic Innovations for South Africa's Geopolitical Energy Futures: Towards a Draft Strategic Framework

This special report meticulously maps a spectrum of innovations – from sustained adjustments to transformative breakthroughs – across governance, technology, economics and societal values, all of which are critical to South Africa's energy metamorphosis. Other key sections of the report detail the preferred futures of energy in South Africa by 2035 and the driving forces and high-impact uncertainties that need to be navigated. There is an explicit call to overcome 'used futures' – ways in which old patterns of thinking and doing about the future are mindlessly assumed and implemented in planning initiatives and behavioural patterns.

The report underscores the significance of alternative framings – ecomodernism, planetary stewardship, pathways to sustainability, critical post-humanism, post-growth and the great simplification – in informing South Africa's energy transition strategies. These framings offer diverse perspectives on energy development, sustainability and global interactions, unveiling a spectrum of possibilities to guide policy decisions.

The implications of this research reverberate across international relations, economic paradigms and environmental sustainability. As we stand at a crucial juncture, the report

presents pragmatic recommendations that embrace integrative approaches, transparent collaboration, innovation, education and policy flexibility. These recommendations are rooted in evidence, poised to guide policymakers in forging a resilient and regenerative energy landscape.

The report challenges conventional thinking, offering a rallying call to re-evaluate economic growth paradigms, enhance global cooperation and prioritise intergenerational equity. By adhering to these recommendations, South Africa can pioneer a regenerative economy that fosters responsible resource management, environmental stewardship and equitable prosperity. As we navigate the complexities of energy transition, let us unite to shape a better future for generations to come.

Abbreviations & acronyms

AI	artificial intelligence
BRICS	Brazil, Russia, India, China, South Africa
CLA	Causal Layered Analysis
COP	Conference of the Parties
GDP	gross domestic product
JET	Just Energy Transition
NDCs	Nationally Determined Contributions
PCC	Presidential Climate Commission
REIPPPP	Renewable Independent Power Producer Programme
STEEPV	Social, Technological, Economic, Environmental, Political and Values

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The CST is a flagship research and teaching hub at Stellenbosch University. It brings together complexity thinking, sustainability science and transdisciplinary research across five themes: knowledge co-production, social-ecological resilience, transformative futures thinking, finance and resource flows, and political economy and development. The CST offers a Postgraduate Diploma, MPhil, and PhD in Sustainable Development. Both teaching and research activities are theoretically grounded in complex adaptive systems, human-nature interconnectedness, socio-technical transitions and social ecological transformations.

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SAIIA's special reports are fairly lengthy analytical papers, usually reflecting on and analysing the findings of field research.

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Introduction

In the realm of global energy transition, few regions hold such significance and promise as Southern Africa. The confluence of geopolitical dynamics, energy demands and sustainability imperatives intersect here with resounding impact. This special report emerges as a response to the pressing urgency in South Africa's energy landscape, poised at a critical juncture as it navigates the complex labyrinth of shifting energy paradigms, climate imperatives and geopolitical intricacies. The journey towards sustainable and transformative energy futures for South Africa has never been more imperative, as the nation grapples with the challenges of balancing economic progress, energy security and environmental stewardship.

In an era defined by rapid technological advancements, shifting global dynamics and a growing awareness of environmental concerns, the energy landscape is undergoing a transformation of unprecedented scale. This report delves into the intricate realm of critical minerals in Southern Africa, where the convergence of geopolitics, energy transition and sustainability creates a nexus of immense significance. The report is a comprehensive exploration of the challenges, opportunities and potential pathways that lie ahead.

The urgency of this research stems from the undeniable imperative to transition towards sustainable energy sources, while addressing the complex geopolitical and economic considerations intertwined with the region's resource-rich reality. Southern Africa, characterised by its abundance of critical minerals essential for renewable technologies, finds itself at a crossroads where responsible resource management must be harmonised with national development goals, global environmental targets and equitable distribution of benefits.

This analysis delves into the multi-faceted dimensions of this monumental transition, guided by the Three Horizons Framework, an innovative approach that dissects the current status quo (Horizon 1) and, bridged by a transition phase (Horizon 2) of innovation and disruption, envisions a preferred future (Horizon 3). This report maps a spectrum of innovations – from sustained adjustments to transformative breakthroughs – across governance, technology, economics and societal values, all of which are critical to South Africa's energy metamorphosis.

The key questions that underpin this analysis are:

- How can South Africa fortify its energy infrastructure, not only to meet current demands but also to propel sustainable development?
- How might a just transition unfold, balancing environmental conservation with socioeconomic equity? What role does international collaboration, particularly

with strategic partners like China and India, play in catalysing South Africa's energy transformation?

- How can Southern Africa harness its critical mineral wealth to propel an energy transition that aligns with environmental imperatives?
- What geopolitical and economic implications arise from this transition, and how can South Africa leverage its position to shape a more equitable global energy landscape?
- How do alternative framings, such as eco-modernist, planetary stewardship, pathways to sustainability, critical post-humanism, post-growth and the great simplification, inform policy decisions and shape the trajectory of energy development?
- What can we learn from the scenarios for the futures of energy geopolitics in South Africa by 2050?

These are the questions that compel this investigation and beckon us to reimagine a trajectory that avoids the pitfalls of inertia and aligns with the aspirations of the nation. Through a rigorous exploration of these questions, this report aims to provide policymakers with a systemic understanding of the multifaceted factors at play in shaping Southern Africa's energy future. By examining alternative framings, it offers insights into diverse perspectives that can guide South Africa's energy policies and decision-making processes.

However, the report also delves deeper, uncovering the high-impact uncertainties that loom over South Africa's energy trajectory. It dissects relevant examples, including the spectre of polarised political interests, challenges in skills development, infrastructure resilience and the dichotomy between carbon transition and energy demands.

This report finds us at the nexus of opportunity and challenge. It endeavours not only to provide an informed analysis but also to ignite the imagination of stakeholders, policymakers and citizens alike. The metaphor of 'survival of the fittest' no longer suffices. Instead, through a lens of collaboration, innovation and sustainable stewardship, this report seeks to invoke a new metaphor – a compass that guides South Africa towards an equitable, prosperous and sustainable energy future. This exploration navigates South Africa's transformative journey in the intricate tapestry of geopolitics and energy transitions through 2050.

The conclusions, drawn from extensive stakeholder engagements and in-depth scenario building, encapsulate a preferred future that is a more equitable and viable vision for South Africa's energy landscape by 2050. It envisions a future where sustainable and inclusive energy access is the norm, driven by decarbonisation efforts that harmonise with social and economic justice imperatives. A decentralised energy paradigm is integral, fuelling rural development and creating a resilient fabric of distributed energy networks. Collaboration with global partners, particularly China and India, stands as a cornerstone of this transformation, leveraging technological innovation for sustainable development.

Moreover, a diversified and sustainable transportation ecosystem, coupled with increased digitalisation, shapes a thriving society that is both environmentally conscious and technologically advanced.

The conclusions drawn underscore the complexity of navigating Southern Africa's geopolitical energy transition by 2050. The interdependence between human well-being, environmental stewardship and resource management requires multifaceted approaches that extend beyond traditional paradigms. Whether embracing eco-modernist ideals, pursuing pathways to sustainability, adopting a planetary stewardship perspective, embracing critical post-humanism or contemplating post-growth scenarios, South Africa stands at a pivotal juncture where decisions will echo through generations.

This report advocates for a bold and forward-thinking approach that integrates principles of intergenerational fairness, environmental responsibility and social equity. It emphasises the need for nuanced, adaptable policies that account for the dynamic interactions between diverse stakeholders, technological innovations and evolving global contexts. This report equips policymakers with the knowledge and insights to navigate the intricate landscape of critical minerals, geopolitical dynamics and energy transition.

The pages of this report invite readers to embark on a transformative exploration of Southern Africa's energy future. The path ahead is illuminated by the fusion of innovative ideas, geopolitical considerations and ethical imperatives, all converging to shape a more sustainable, equitable and resilient energy landscape for the generations to come.

Navigating the geopolitical energy transition

Sustained and transformative innovations

Innovations are categorised as sustained innovations, which prolong the current system, or transformative innovations, which pave the way for radically different Horizon 3 systems. Horizon 3 highlights the innovations needed to achieve the preferred geopolitical energy futures for South Africa, as put forth by workshop participants. These innovative advancements embody a transition zone (Horizon 2) characterised by an entrepreneurial and culturally creative environment. In this zone, feasible technological, economic and cultural innovations can potentially disrupt and transform the existing system (Horizon 1) to different extents.

Sustained and transformative innovations are thematically organised across 1) governance and process; 2) infrastructure and technology; 3) social and values; and 4) economics. The overwhelming majority of sustained and transformative innovations relate to governance, process and social values for South Africa – namely, the need to foster increased private sector investment in energy infrastructure and to decouple the concepts of stunted economic development and decarbonisation of energy systems. The innovations posit a South Africa where energy-related public-private partnerships thrive and decarbonisation supports socio-economic security, inclusivity and well-being.

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Governance and process themes contributed by participants during the Three Horizons Framework Workshop

Sustained innovations:

- Increase community engagement and consultation processes in energy policy decisions;
- Develop government capacities for effective energy transition management at local, provincial and national levels;

- Invest in skills and knowledge for efficient resource use;
- Strengthen political hybrid intermediary institutions like the Presidential Climate Commission (PCC) to expedite political deadlock and facilitate pathways for change in the energy transition;
- Focus on reducing energy sector corruption by applying new accounting methods and leveraging new technology to track consumption in the modernised distribution infrastructure;
- Improve government transparency to reduce corruption opportunities;
- Emphasise political will and local content inclusion;
- Explore the opportunity for municipalities and cities to transition to owning power purchase agreements and participating in large-scale renewable energy projects. (this is a similar approach to that of energy projects in Melbourne);
- Foster improved regional stakeholder relationships and alignments, such as the Southern African Power Pool;
- Seek funding collectively as an economic bloc, not by individual countries; and
- Strengthen relationships with the Global North and BRICS countries to access finance, technology and skills transfer.

Transformative innovations:

- Prioritise non-government ownership of energy infrastructure;
- Encourage private sector participation to promote and incentivise innovation in the energy sector;
- Allocate resources for research on and development of water, energy and food system interconnections;
- Support the deployment of green hydrogen-powered transportation in support of reduced emissions;
- Invest in energy-efficient public transportation such as electric buses and hydrogen-powered trains;
- Implement regulation preferences to boost domestic investment; and
- Position infrastructure projects as attractive investments by offering incentives, tax breaks and streamlined processes for local businesses and investors.

Infrastructure and technology themes contributed by participants during the Three Horizons Framework Workshop

Sustained innovations:

- Link decentralised renewable energy systems into a regional energy network, to enhance energy security and prevent reliance on large-scale projects;
- Encourage the development of micro-grids in local energy systems, enabling communities to form cooperatives to self-govern energy resources;
- Encourage regional distribution systems across various energy sources to improve energy accessibility and reliability;
- Develop infrastructure investments to foster regional integrated value chains, promoting economic growth and sustainability;¹
- Strengthen capacity in renewable energy manufacturing through investment in skills and technology transfer; and
- Invest and deploy small-scale renewable technologies in rural and marginalised communities, while collaborating with them, to create awareness campaigns to make renewable energy solutions viable and sustainable.

Transformative innovations:

- Incentivise circular economy practices for industries and businesses to minimise waste;
- Develop waste-to-energy plants to support sustainable desalination and waste management practices;
- Invest in Fischer-Tropsch technology for waste-to-hydrogen conversion;
- Allocate resources for smart grid technology and data use;
- Use real-time data for energy management and waste reduction;
- Integrate carbon tracking applications on mobile devices to improve environmental awareness;
- Establish a green energy certification system to increase transparency;
- Explore communal green energy financing systems to enable communities to be part of the energy transition;
- Prioritise investments in advanced renewable energy storage technologies;

¹ There are best practices such as in Sierra Leone, where innovative green charging models are implemented as sustainable solutions to expand access to renewable energy sources.

- Offer financial incentives for green technology adoption such as the installation of solar panels and the transition from combustion engines to electric vehicles;
- Update building codes to allow for the use of energy-efficient construction materials and renewable energy sources; and
- Create programmes and funding for green entrepreneurship and sustainable tech startups.

Values and social themes contributed by participants during the Three Horizons Framework Workshop

Sustained innovations:

- Increase social dialogue and stakeholder engagement for just energy transitions (JETs), to address real needs and challenges, by exploring scenarios and possible future applications;
- Implement an expanded curriculum on climate change in schools to raise awareness and deepen the understanding of climate issues and their impact on youth;
- Invest in nature awareness campaigns to shift the intrinsic value of nature and its fundamental role in the economy – through increased education and awareness, the harmful narrative that suggests Africa’s development must come at the expense of climate preservation will be challenged;
- Address inequality by including alternative energy finance systems under socialist frameworks, which could curb vandalism and corruption by changing public perceptions of infrastructure and blur the lines between citizens and the government;
- Encourage parliamentary advisory bodies, such as the PCC and the electricity secretariat, to prioritise inclusivity and representation of groups affected by energy poverty;
- Reframe energy transitions as viable solutions to help lift people out of poverty, make the transition benefits more tangible and, in turn, increase buy-in;
- Promote diverse collaboration with primary economic sectors to assess and address the risks associated with energy transitions;
- Support initiatives like retraining and reskilling workers for the renewable industry to foster advocacy and promote mobilisation among workers in the green sector;
- Redefine energy as a public good and promote the accessibility and affordability of renewable energy sources, recognising and addressing the emergence of enclaves among the middle class seeking to escape broader societal challenges; and
- Encourage a shift in the philosophy informing urban planning and mobility by leveraging increased urbanisation for rethinking energy use and sustainability.

Transformative innovations:

- Encourage a 'slow' lifestyle to counter increased consumption;
- Promote educational programmes and awareness campaigns for renewable-based living;
- Explore funding for green clinics to aid sustainable lifestyle adoption;
- Use green clinics and tracking tools to reduce environmental impacts;
- Celebrate local projects regardless of a 'social entrepreneur'² label;
- Foster regenerative cultures emphasising consumption reduction;
- Value shorter local supply chains and support local businesses; and
- Reduce waste and promote sustainable production and consumption.

Economic themes contributed by participants during the Three Horizons Framework Workshop

Sustainable innovations:

- Prioritise increased investment in transmission grids through public and private funding to address the investment deficit in energy infrastructure;
- Explore alternative income sources to reduce reliance on liquid fuel levies, to help delink fuel sales from fiscal benefits and create more stable and diverse revenue streams;
- Explore and adopt degrowth and post-growth paradigms supporting alternative economic and energy models;
- Invest in comprehensive strategies to moderate the high consumption levels of imported liquid fuels by incentivising energy-efficient practices and using alternative, domestic energy sources;
- Counter fear-based narratives to address competition and international relations concerns through diplomacy, cooperation and transparent communication with the international community to build trust and mitigate resistance to needed changes; and
- Implement full-cost energy and energy systems pricing to ensure that the true costs, including environmental and societal impacts, are reflected in energy pricing, to influence responsible consumption and support the transition to cleaner and more sustainable energy sources.

2 A social entrepreneur is interested in starting a business for the greater social good, not just pursuing profits. Social entrepreneurs may seek to produce environmentally friendly products, serve an underserved community, or focus on philanthropic activities.

Transformative innovations:

- Develop sustainable and innovative financing models that allow local governments to access capital for infrastructural and technological development, without incurring debt or having international funders impose restrictive conditions;
- Foster a robust partnership between local and development banks to promote economic growth and job creation by investing significantly in South African projects, including infrastructure, community initiatives, repurposing projects and manufacturing facilities;
- Expedite the release of funds from the PCC to catalyse additional finance for South Africa's transition initiatives, to commence sustainability projects without delay;
- Implement demand management measures by focusing on per capita energy consumption and implementing punitive measures to encourage energy-efficient practices;
- Encourage a shift away from carbon-intensive consumption habits (eg, promote charging stations over fossil fuels) and promote virtual meetings as opposed to commercial travel;
- Develop policies and strategies to decouple economic growth from resource consumption by encouraging sustainable and circular economy practices to minimise environmental impacts; and
- Use blockchain technology for carbon emissions trading to create a transparent and efficient marketplace for carbon credits to incentivise emissions reductions.

This section concludes the contributions from workshop participants where the focus was on sustained and transformative innovations.

Pockets of the future in the present

The following section of the workshop focused on pockets of the future in the present (also termed seeds) with respect to South Africa's geopolitical-energy nexus. These seeds represent fringe activity in the present system, introducing novel ways of doing things and with the ability to coalesce to shift the dominant system.³ As detailed below, seeds contributed by participants include climate finance innovations, decentralised energy systems, regulatory and infrastructural provision for new energy technologies (eg, hydrogen) and normative shifts around energy use.

³ Laura Pereira et al., "Seeds of the Future in the Present: Exploring Pathways for Navigating Towards Good Anthropocenes", in *Urban Planet: Knowledge towards Sustainable Cities* (Cambridge: Cambridge University Press, 2018), 327–350.

Seeds of the future in the present:

- Innovate decentralised payment mechanisms for electricity;
- Leverage electrification for everyday items, such as cell phones, as energy sources;
- Promote climate- and energy-conscious consumers and producers;
- Access tailored funding from financiers for green and the JET;
- Facilitate technology transfer from developed to developing economies;
- Monitor global vehicle manufacturers' transitioning to electric vehicles and alternatives;
- Adapt to the rise of AI and evolving job markets;
- Encourage continued gas development in African countries;
- Repurpose electronic waste for various applications;
- Implement decentralised energy solutions for rural electrification;
- Drive the [Green Hydrogen Roadmap](#) led by the Department of Science and Innovation;
- Learn from successful just transition examples in Germany and Canada;
- Explore blockchain for renewable energy technology-sharing at the residential level;
- Collaborate with academic institutions on battery mineral research and innovation;
- Promote green hydrogen commercialisation;
- Extend coal life and offshore oil and gas investments;
- Focus on battery storage technologies, eg, vanadium redox flow batteries;⁴
- Implement carbon tax and anticipate carbon border adjustment mechanisms;
- Align with the Paris Agreement and its Nationally Determined Contributions (NDCs);
- Engage business associations in enhanced gas utilisation efforts;
- Promote small-scale, cost-effective energy generation and storage systems;
- Observe debt-for-climate swaps with partial debt relief for climate investments;
- Address technology implementation by private sector entities with clear policy and regulations to prevent the formation of energy enclaves;
- Monitor China's leadership in setting energy and technology standards;
- Focus on energy skills development with the [SANEA Energy Skills Roadmap](#); and

⁴ The vanadium redox-flow battery is a novel energy storage device for power grid applications. As the catholyte or anolyte is cycled, charge is added or withdrawn from the reactant tanks via a membrane.

- Leverage the [Green Hydrogen Economy \(GHE\)](#) in the TVET – GHE study, to support labour absorption rates.

Also see:

- The recent launch of the [eThekweni Regional Hydrogen Strategy](#) in support of alternative energy sources;
- Initiatives like [Zonke Energy's microgrid pilot](#) and [Anglo American's hydrogen mining truck](#);
- [Eskom's battery projects](#), which are under construction;
- [Sasol's sustainable aviation and synthetic fuels pilot](#);
- The [Renewable Energy and Battery Minerals Masterplans](#);
- South Africa's evolving relationship with BRICS countries, as well as the recently selected additional countries that will form part of the BRICS bloc;
- Development finance institutions to fund cleaner tech projects;
- Policy and stimulus-based trade wars between the EU, US and China;
- The [cap and trade system in climate policy](#); and
- The widening climate policy and commitment gap between nations.

The listed seeds are observable practices or ideas that are currently rare and insignificant in the present moment but have the potential to become more prevalent and impactful. The seeds can also be viewed as weak signals of change that have the potential to profoundly influence the geopolitical energy landscape of South Africa.

During these workshops, participants applied the sustainable and transformative innovations and the seeds of change, and through creative skills wove them into a story. The following section provides a synopsis of one of the stories generated.

Our story

This collective story is not a prediction or forecast of what could or will happen. It highlights a combination of assumptions, trends and drivers of change, illustrating possible, probable, plausible and preferred futures. The intent of 'our story' is to imagine alternative futures and then describe how those futures might develop. This allowed participants to think about uncertainty in a structured way, building and informing strategic conversations. Stories about the preferred future may help leaders frame their fundamental understanding of the future and achieve their goals.

This is one such story developed by workshop participants.

In South Africa, plagued by political corruption, economic stagnation and environmental decay, a diverse group of passionate individuals unite to spark a transformative journey towards a brighter future, where sustainable energy, economic growth and social equity reign supreme.

Meet Sizwe, a brilliant engineer who dreams of liberating South Africa from its coal-dependent energy nightmare. He is joined by Thandi, an inspiring advocate for social justice, and Jabu, a tech-savvy entrepreneur unafraid to challenge the status quo.

In 2023, South Africa faced a trifecta of crises: a crippling dependence on coal for power generation, rampant government corruption and skyrocketing unemployment rates, especially among the youth. It seemed as though the nation was on the brink of collapse, while faced with unprecedented levels of load-shedding due to energy supply shortages. Businesses and industries were hanging on for dear economic life as students exchanged dark classrooms for well-lit spaces under trees.

But amid the chaos, seeds of change were sown. Legislative drivers, like the Extended Producer Responsibility Act, paved the way for innovative recycling and waste-to-energy solutions. Brave private sector pioneers ventured into green technologies, without clear government policies and regulation. The SANEA Energy Skills Roadmap offered hope for the future, by preparing the workforce for the challenges ahead.

The sparks of innovation ignited a fire of transformation. Sizwe and his team led the change in developing waste-to-energy and waste-to-hydrogen technologies, catalysing Fischer-Tropsch expertise to reduce waste and create clean energy sources. A sustainable financing model allowed local governments to fund infrastructure projects without incurring debt or compromising on conditions. Smart-grid technologies harnessed data for greater energy efficiency. This resulted in less energy use and reduced energy poverty on the continent.

As these innovations took root, South Africa began to flourish. By 2050, the nation had undergone a remarkable renaissance. Equitable access to services, reduced corruption and economic opportunities for all became the norm. Sustainable, affordable and equitable energy access was not just a dream but a reality. Circular economy systems thrived across waste management, energy generation and transportation.

South Africa is a tale of resilience, innovation and collective action that highlights the incredible potential of its people and how to overcome adversity and build a brighter future. It is a story of hope, where individuals from diverse backgrounds unite to prove that, even in the darkest of times, the human spirit can prevail and a nation can rise from the ashes to create a better world for current and future generations.

CHAPTER 3

Wayfinding geopolitical energy futures

As outlined in the research design, stakeholder workshops centred on exploring and mapping viable geopolitical and energy futures for South Africa through the Futures Literacy Lab and Three Horizons Framework methodologies. As a part of the Three Horizons Framework activities, participants articulated preferable (desirable) visions of the future for the region related to the geopolitics-energy nexus by 2035. These visions represent aspirations for a better world to eventually replace the current failing system (Horizon 1). Importantly, generating these visions offers a collective understanding of long-term goals and can help identify areas that need urgent intervention and guide goal-setting and strategic planning.

As articulated by workshop participants, preferred geopolitical energy futures in South Africa by 2035 would constitute the following.

Sustainable and inclusive energy access

Sustainable energy services are accessible and affordable for all, ensuring equity in energy access by applying an integrated approach and philosophy. This is a multifaceted and critical issue that encompasses not only environmental sustainability but also social and economic inclusivity. Reducing the environmental impact of energy generation is paramount and accomplished through adopting renewable energy sources. All segments of society, including rural and marginalised populations, have reliable and affordable access to energy. Infrastructure development and policy reforms successfully address and redress economic disparities. Local communities are engaged in energy projects and community-based initiatives and partnerships foster a sense of ownership and sustainability.

Reducing the environmental impact of energy generation is paramount and accomplished through adopting renewable energy sources

Just transition and justice

A just (energy) transition is either achieved or well underway, which prioritises both environmental sustainability and social and economic justice for citizens. The transition from fossil-fuel-based energy systems to more sustainable and environmentally friendly alternatives is implemented to be fair, equitable and inclusive for all stakeholders. There is a

transition from focusing only on shareholders – where the motive is profit before people – to catering for all stakeholders – where the environment is considered an active citizen. Proactive measures are taken to ensure that the benefits of the transition are more equally distributed to all stakeholders, not only shareholders. The rights and livelihoods of workers and communities are catered for through retraining and reskilling opportunities, ensuring active participation in the emerging green energy sector and no one is left behind.

The potential for resource conflicts remains, increasing demand for the fair allocation of energy sources to promote global stability

Significant investment expedites the transition to cleaner energy sources, resulting in increased mitigation of climate change and environmental degradation through sustainable practices. Local communities are active participants and engaged in decision-making processes and contribute to developing new energy projects and benefit directly from them. Geopolitical energy justice extends beyond national boundaries and encompasses international agreements and cooperation, to address energy-related challenges such as resource distribution and specific policies to redress energy disparities. The potential for resource conflicts remains, increasing demand for the fair allocation of energy sources to promote global stability. Technological disparities are reduced as the equitable sharing of clean energy technology among nations becomes the norm while seeking energy justice.

Decentralised energy for rural areas

Energy systems are increasingly decentralised to increase energy access in rural areas, providing sustainable, reliable and off-grid energy solutions to fuel human and economic development in poorly resourced regions and communities. The rise of alternative energy generation models includes transitioning from centralised energy systems to generating electricity at or near the point of consumption. Energy losses are minimised through the reduction of transmission and distribution lines due to the reliance on decentralised energy systems.

Due to microgrids, rural communities are more empowered and self-reliant. Microgrids serve a dual purpose: they provide a local source of energy and can be integrated with the main grid to alleviate pressure during peak demand cycles in other areas. Decentralised energy solutions are adapted based on demand or changing energy requirements, reducing environmental impacts. The technologies supporting decentralised energy systems have become more affordable, increasing accessibility for a wider range of communities, improving living conditions and fostering economic development. Local

communities are instrumental in the ownership and involvement of decentralised energy systems through planning, development and management. The challenges in advancing decentralised energy systems remain the initial capital costs and lack of technical expertise in communities, which can be overcome through comprehensive planning and local engagement.

Due to microgrids, rural communities are more empowered and self-reliant

Collaboration with China and India

Collaboration with China and India through partnerships, trade and investment offers the potential for sustainable solutions to South Africa's energy crisis. This is accomplished by leveraging solar, hydrogen and other new energy technologies. Both China and India are rich in energy resources, which are leveraged to help South Africa diversify its energy mix. The Indian economy demonstrates resilience to external shocks, compared to other BRICS member states, by being well on its way to meeting its fiscal deficits and ensuring that banks remain well capitalised.

China and India are keen to invest in South Africa's energy sector

China and India are keen to invest in South Africa's energy sector. Through collaborative projects, increased foreign direct investment is attracted, giving rise to the development of energy infrastructure and capacity. The transfer of advanced energy technology and knowledge to South Africa is expedited, giving rise to its energy infrastructure and enhanced energy efficiency. The cost of energy production is reduced due to the benefits of economies of scale achieved through South Africa's collaboration with China and India. By strengthening energy collaborations, trade and economic relations benefit from these relations, giving rise to mutually beneficial economic prosperity for South Africa, China and India. Energy security remains a threat, but collaboration with key countries enhances South Africa's energy security.

Diversified and sustainable transportation

A more diversified and sustainable transport system, including fuel cell-powered and hybrid vehicles, contributes to lower greenhouse gas emissions from fuel production, refining and transportation. Transportation systems are more diverse, enabling improved flexibility and efficiency while reducing the environmental impact of transport. Increased investment in reliable, affordable and accessible public transport options benefits urban and rural communities. In addition, increased investment in rail infrastructure for transporting goods efficiently and reducing congestion improves the sustainability of the transportation sector. Non-motorised transport is encouraged, such as cycling and walking, which further reduces congestion and promotes physical health. The resilience of the transportation infrastructure is improved to cater to climate change's impacts, including adaptation measures to address extreme weather events and flooding. The transportation system is multifaceted, and while the direct benefits relate to reduced emissions and greenhouse gases, the indirect benefits include the improvement of the quality of life of citizens.

In articulating preferred geopolitical futures for energy in South Africa, participants were also asked to engage with the Causal Layered Analysis (CLA) method, which is a group sense-making 'iceberg' technique used to explore the underlying causes and worldviews contributing to a situation.⁵ Working together, the participants identified the following on the geopolitics-energy nexus for South Africa, in this order:

- A headline/litany: How they feel about it;
- Causes: What is creating the situation;
- A worldview: The perspectives shaping the litany and causes; and
- Myths/metaphors: What underlying stories sustain the worldview, causes and litany.

Once completing a CLA exercise pertaining to probable futures for geopolitics and energy in the region, participants were then asked to complete a reverse CLA, beginning instead with the myth/metaphor and working their way up the CLA 'iceberg' towards a correlating headline/litany. This reverse CLA approach presents an opportunity to reshape long- and deeply held assumptions by applying critical thinking, disrupting established myths/metaphors and constructing a novel and often desirable narrative.

As displayed in Table 1, the reverse myths/metaphors developed by participants constitute transformative visions that have the potential to catalyse systemic change. They reflect the aspiration to broker more desirable interactions between fossil fuels, the private sector, energy accessibility, energy consumption and – importantly – societal values of interconnectedness, shared responsibility and care for both the commons and one another.

5 Sohail Inayatullah, "Causal Layered Analysis: Poststructuralism as a Method", *Futures* 30, no. 8 (October 1998): 815-829.

TABLE 1 MYTHS AND METAPHORS AS GENERATED BY PARTICIPANTS DURING THE REVERSE CAUSAL LAYERED ANALYSIS

Myths/Metaphors	
We understand our interconnectedness	Developing countries take the lead
We live 'Ubuntu'	There is no coal in the energy mix
A sustainable energy future for all	Survival of the fittest
There is no reaction from civilians to worsening energy conditions	Significant private participation in public infrastructure – specifically energy, Tx, Dx and storage
Planet Earth will always take care of herself	Social issues as crucial as the environment
The green transition is the way to go	Net zero is achievable
All of Africa is for all Africans. Embracing culture. No xenophobia (and increased trading within Africa). Supporting each other as a continent	South Africa has succumbed to economic colonisation
We all accept that there is only one world and we all must play a role in sustaining it	Energy is a shared resource – and through production and consumption, can support aspects of collaboration and justice
The world lives according to the African notion of <i>ukama</i> – relatedness to each other, nature and past/present/future (via ancestors or equivalent)	Planetary approach to energy security
South Africa is resource efficient and offers energy security to the benefit of all its population and supports other countries on this pathway	Decolonialised learning: embracing indigenous knowledge and equal opportunities for quality education
EVs are the only vehicles on our roads	A geopolitical consensus where peace is possible because of a shared sense that we live on a finite planet that needs to be shared by all
Because of the devastating consequences of climate change affecting billions (especially the poor), everyone finally accepts that fossil fuel-based energy must end	South Africa owns and is in control of its energy landscape
South African companies are globally competitive and we import less without South Africans paying excessively because we are cost-effective	Energy is renewable, climate-compatible, cheap, efficient, abundant and available for the human development
Diverse leaders and owners of assets, businesses and land	Some for all, forever!

Source: Compiled by the authors

Preferred futures

In addition to the challenges outlined in the introduction of this report and in alignment with the principle of co-creation, a compilation of influential factors has been generated. In the context of futures and foresight, these uncertainties are termed 'known unknowns.' They are identifiable elements that shape the future, yet their specific outcomes remain uncertain and carry substantial impact. They are commonly referred to as 'driving forces shaping the future' or 'drivers of change,' and are intricately interconnected. Table 2 presents the collection of driving forces within the South African geopolitical energy ecosystem.

Driving forces in the South African geopolitical energy ecosystem

Participants in the first Geopolitical Energy Futures: Implications for South Africa workshop were asked: ‘What are the geopolitical high-impact key uncertainties for South Africa’s energy ecosystem?’ Participants consisted of members of private firms, public offices, research institutes, international NGOs and universities. Answers were categorised using the STEEPV (Social, Technological, Economic, Environmental, Political and Values) framework and provided interesting insight into the key uncertainties in the geopolitical landscape.

TABLE 2 STEEPV ANALYSIS

Social	Technological	Economic	Environmental	Political	Values
Disillusioned youth and voters abstain from participating in the democratic process	Question: Will South Africa be the last outpost for internal combustion energy vehicles?	Resources and raw materials pricing for new tech soars with global demand	Net zero commitment by 2050 required	Coalition governments	Move away from scarcity mindset
Political factionism	Understanding the place that natural gas plays in the energy transition	Global climate change policies impact trade	Energy security and its effects on food and water security for already vulnerable communities	North-South divide over finance and responsibility for climate action and reliance on failing promises and commitments	Biodiversity has an economic as well as social value – we need to recognise it
New models of ownership emerge such as commoning, co-ops, etc.	Transmission grid debottlenecked	Affordable finance available	High-impact climate disasters forcing action quicker	Dealing with dysfunctional, corrupt and weak parastatal entities	Populism is not equal to competence
Pilot green energy projects deployed in local communities to test different models of ownership	Business models with Power Purchase Agreements outside of the REIPPP	Independent market operations at all cascaded levels	Solar and wind technology recycling options	Global scientific consensus on the state of the planet (largely unreported in South Africa, causing ignorance) is changing the ethical compass for many in global policy decision-making	We appreciate and build the capabilities for partnering

Social	Technological	Economic	Environmental	Political	Values
Civil society/ traditional authority is more vocal	Renewables' futures are misconceived as solar and wind only while there are very few places this is possible. Solar & wind require battery back-up, ie, lithium or vanadium, plus gas (potentially H ²)	Pressures to reconfigure the global financial system, which prevents investment in the real economy on scale	Heritage protection generates green jobs	Electricity is of no value unless the person who clicks the switch can either use it to improve their life or create economic value with it	Decolonise thinking to make space for the emergent qualities of the JET
Ubuntu principles are implemented	Independent transmission operator at all levels – national, regional/ provincial, district, local	Sharing the economic risks and costs of a new energy system fairly among all stakeholders	Profitable solution to waste & plastic recycling developed	Patronage is not equal to politics	Ignoring the social divide and increasing poverty does not make them go away
Workers within the emerging renewables industry organising and mobilising	The need to align technological sources with economic systems	Move away from the dollar as the global currency linked to international trade, exposing various alternatives	Energy required to manufacture all these green technologies and the material intensity it will have on the African continent due to global demand	Global coalitions for climate finance fail BUT it is a vital line to invigorate local institutions	increased recognition for the importance of starting now with action even if it is small rather waiting only for big plans
Increased prevalence of crime due to high unemployment and disillusion with the government	Technology localisation	Affordable finance available	Ineffectiveness of global net zero targets due to wealthy nations buying their way to meet targets	All countries become more protectionist as climate effects intensify	Need to create skills and employment for Africa's youth (one of the biggest continental assets given the ageing global workforce)

Social	Technological	Economic	Environmental	Political	Values
Energy access & affordability – making sure this social aspect is included in energy planning and policy as well as implementation	Greater investment in the national grid to enable Net Zero 2050	Attempts to financialise economic and energy development	Negative environmental impacts causing disasters across the board in many countries are unprecedented and changing policy decisions	Geo-political conflicts likely to worsen, especially if Donald Trump wins the US election again – impacting negatively on SA's trade, finance, investment levels	Working in an integrated manner, ie, Team South Africa rather than silos
	Energy choices should not be technology dependent. Dump the Integrated Resources Plan	Cost driver of renewable firm energy versus any other energy cost (nuclear, fossil, etc.)	The climate resilience of the current energy infrastructure	Remove political interference in energy choices	
	Automation and digitalisation leading to job losses			Political dominance of the Global North	
	Availability/ access of critical minerals and manufacturing capability for key technology in the value chain			Dealing with dysfunctional, corrupt and weak state-owned entities	
				Increased involvement from capable young leaders – onus on current govt to enable their development/ recruitment and to convince them that public service is worth it	

Source: Compiled by the authors

Interesting ideas that emerge from the STEEPV framework

- When political tension exists between North-South relations or within national governments, it emerges as a key uncertainty because the government still has a role to play in the energy transition. This has consequences and impacts how that energy transition both globally and nationally will play out.
- This political dimension is balanced out by the emergence in the social sphere of alternative and opposing views, mobilising around civil and traditional authorities, community-level projects and workers within the energy sector, while also shifting towards new organising philosophies like 'ubuntu'.
- At the highest level of visibility, technological uncertainties emerge as particular challenges with which to contend. That technology is central to the energy transition and at the heart of tension between social and economic development is clear. The means by which such technology for the energy transition is financed, its connection to the real economy and international power dynamics are also raised.

High-impact key uncertainties

- **Urbanisation and youth population boom:** In South Africa, we see rapid urbanisation and the youth population's tandem growth. This causes an increased demand for energy and technology services (including data and data servers) and increased strain on public infrastructure, promoting short-term mitigation strategies by local governments. This urbanisation and population boom also exacerbates urban pollution and poor living conditions.
- **Polarised political interests:** South Africa contends with differing views of what is causing the energy crisis and ideas of what should be done to get out of it. Opinions differ on whether the country should transition to green energy and exploit its renewable reserves, or not transition and exploit its coal reserves. These different views and ideas subsequently affect the funding needed to enact most legislation to get the nation out of the crisis. This leads to perpetual load-shedding, a substantial knock to the economy and high unemployment rates.
- **Infrastructure resilience and adaptability:** The ageing infrastructure is unable to support the increasing energy demand and is unable to support an increasing energy mix (traditional coal and nuclear) and now transitioning to a centralised energy mix. In addition, existing infrastructure only supports energy generation from a central source and the power dynamics are transitioning to a centralised model.
- **Growing climate crises despite minor solutions/reform:** Growing climate change and environmental degradation through floods, droughts, air and water pollution and acid drainage affect South Africa despite political, social and technological reform. The environmental movement gets more radical while climate deniers/status quo forces are in charge. Solutions to carbon emissions reduction lead to greater unforeseen problems.

Positive tipping points for clean energy generation are not realised despite best efforts. There are no silver bullets to stop climate change. Geopolitical challenges to the NDCs and other important policy targets are not met.

- **Skills shortage to support decarbonised economy:** Despite the unemployment rate in South Africa (currently 35%), the skills to enable and support a decarbonised economy are not prevalent. The demographic patterns illustrate that there are enough young people (ages 15-35) to produce energy, but the skills to support this transition are not available. This will require significant investment.
- **Escaping the carbon trap while meeting energy demands:** South Africa is caught in a carbon trap – ie, trying to meet NDCs to emission reductions, decrease pollution and shift to green/cleaner energy, while meeting the rising energy demands for electricity, transport and food production. The combination of increased inflation, rising costs of electricity and increased reliance on foreign direct investment for new energy generation (through the Just Energy Transition Partnership) leads to increased dependence on loans and grants. South Africa struggles to achieve new business models to trade electricity due to dependence on Eskom and growing requirements for local content and local ownership of energy projects. South Africa increasingly requires pathways to reduce carbon emissions while growing the economy.
- **Centralised energy generation:** Coal remains the dominant energy source in South Africa, catering to 85% of the nation's energy needs. However, despite strong political and commercial ties to coal and Eskom, this reliance has proven detrimental to the country. Eskom faces challenges, including neglected maintenance over extended periods, outdated infrastructure, rising unscheduled breakdowns, non-compliance with air pollution regulations, a dearth of long-term planning, slow adoption of alternative energy solutions, substantial debt and the ongoing battle against corruption and internal sabotage.
- **Inadequate funding for continued green investments and consumption:** There has been increasing focus on extending the useful life of critical technologies that are reliant on fossil fuels. These investments compete with green investments, highlighting the increasing demand for more sustainable projects where the focus is on protecting the environment. The emergence of green finance tools to support decarbonised economies will continue to gain traction, favouring first movers and thereby deepening inequality.
- **Accelerated growth of digitalisation and AI:** In the last decade, the Southern African region has witnessed a significant shift towards digitalisation, leading to a growing reliance on data across various aspects of business and society. Industries like mining, agriculture, healthcare and education are poised to gain substantial advantages from embracing technologies such as blockchain, 3D printing, AI/machine learning, internet of things and data science. The integration of these innovations has the potential to enhance service delivery, enable efficient food traceability and foster local manufacturing capabilities.

- **Democratic recession:** Over the past decade, the African region, particularly Southern Africa, has witnessed a concerning decline in democratic practices, evident in the rise of civil conflicts, terrorist insurgencies and a resurgence of coups aimed at overthrowing elected governments. Even in South Africa, which has enjoyed a stable democracy for three decades, there has been a noticeable decrease in voter turnout due to rising apathy and loss of confidence in the national government. This trend might lead to the formation of coalition governments, exacerbating challenges related to policy implementation and public service delivery.
- **Large uptake of decentralised energy technologies:** Energy pricing and continued blackouts have shifted public attitudes toward energy to a large uptake in decentralised energy technologies like wind, solar, green hydrogen, small modular nuclear reactors, etc. The private sector provides new finance models to enable people to insulate themselves from large national grid failure and to adopt more sustainable energy consumption behaviours. New token models for sharing demand-side excess energy through local co-ops and energy commons enable onboarding and growing smaller micro-grid systems.
- **Lack of needed regulation:** There is a shortage of regulatory frameworks and models to support the JET in a socially equitable manner. This could result in many not having access to electricity due to the rising cost of energy generation and distribution. This could give rise to nihilism among the large number of unemployed youth displaying their dissatisfaction with events through mass action and riots.
- **Energy affordability and cost-of-living crisis:** The rising global demand for energy due to the decrease in fossil fuel subsidies, increase in fossil fuel prices due to scarcity issues, increase in electricity costs due to inflation and need for large-scale infrastructure energy projects, and extreme heat or cold due to climate change leads to an energy affordability crisis and the deepening of the cost-of-living crisis. The challenge of meeting peak energy demand with baseload energy supply of renewables leaves households with rising costs to travel to work, pay for electricity and pay for food.
- **Energy and minerals blindness:** South African decision makers are caught between an economic growth mindset and bear economies, hoping that green tech will provide the new energy required, but renewables are rebuildable and require more materials than ever. A consumption mindset leads to people's energy and materials blindness.
- **Increasing green finance deficit:** The need to bridge the climate and green finance deficit is ever increasing, while energy investment in the Global South (including South Africa) continues to be viewed as high risk. Alternative funding models as well as the increased role of the private sector in countries such as South Africa are needed to facilitate socially inclusive decarbonisation of the economy.

Challenging used futures of energy

The decisions taken today about energy will heavily influence the prospects of achieving preferred energy futures. Current evidence from critical futures studies⁶ suggests a continuation of applying ‘used futures’⁷ in energy interventions. According to Inayatullah, used futures is an image of the future that ‘is unconsciously borrowed from someone else,’ which imitates ‘what everyone else is doing.’⁸ Another way of describing used futures is as a vision or concept of the future that originated in a different context yet subconsciously influences us, potentially obscuring more genuine and empowering visions of what lies ahead. It is the work of critical futures and critical systems thinking to interrogate these used futures as they are applied to geopolitical energy futures. In the face of multiple intersecting complex energy challenges, following the same kind of thinking and images of the future will not provide alternative outcomes. Merely improving efficiency and productivity – or modifying current dominant approaches using more technical solutions – will not be adequate to address the scale and complexity of wicked energy problems.

Merely improving efficiency and productivity – or modifying current dominant approaches using more technical solutions – will not be adequate to address the scale and complexity of wicked energy problems

We propose that these used futures be identified in terms of the failures of the current system, to clearly articulate the dynamics at play when used futures inform long-term decision-making.

During the Three Horizons Framework exercise with expert South African geopolitical and energy stakeholders, four failures of the current system – ie, the ‘status quo’ – were articulated. These failures constitute Horizon 1 of the Three Horizons Framework and describe the current state, values, present needs and even ‘best practice’ approaches that are increasingly no longer fit for purpose. Broadly, the identified failures of the current geopolitical-energy nexus in South Africa as articulated by participants are:

6 Jim Dator, “Richard Slaughter: Critical Futures and the Knowledge Base of Futures Studies; Evaluation of a Selection of Slaughter’s Published Work”, *Futures* 132 (September 2021): 102792, <https://doi.org/10.1016/j.futures.2021.102792>.

7 Sohail Inayatullah, “Six Pillars: Futures Thinking for Transforming”, *Foresight* 10, no. 1 (January 2008): 5, <https://doi.org/10.1108/14636680810855991>.

8 Inayatullah, “Six Pillars”, 5.

- **Unfulfilled social contract:** The government's failure to deliver public services (namely the stable supply of power) and function transparently has diminished the promise of a bright future for South African citizens.
- **Lack of youth-targeted skills development:** There is a failing basic and vocational education system, in the face of high unemployment, particularly for youth. Insufficient and inappropriate skills development hinders the capacity to successfully ensure a just energy and labour transition.
- **Dependence on coal:** South Africa is over-reliant on a single natural resource for power generation and to uphold its economy, exposing the country to undue risk in the highly uncertain contexts of decarbonisation and shifting geopolitical tectonics.
- **Corruption and instability:** Corruption, political instability and parochial interests negatively impact the investment climate and the integrity of governance in South Africa.

There were, however, elements in the current system identified as worth conserving by the participant group.

- That renewables do have a clear space in the South African electricity market, evidenced through programmes such as the REIPPPP;
- Growing multilateral partnerships such as BRICS, which allow the diversification of power which South Africa may be able to leverage towards a just transition; and
- The establishment of bodies such as the PCC to overcome pluralistic policymaking structures and improve the coherency of national climate and energy governance.

Mapping these failing characteristics and elements to conserve is significant to make explicit the assumptions held about the current paradigms and, consequently, to allow a reframe of what we think, want and need to do to transform the current system to achieve desirable alternatives.⁹

South Africa is in a polycrisis fuelled by energy security uncertainty amid global conflict, increasing global energy demand, tepid global economic growth and increasingly volatile environmental risks. The metaphor or myth associated with this used energy future is 'survival of the fittest,' 'each to their own,' or 'dog-eat-dog.' Metaphors and myths are powerful in shaping the present, representing the future and actively shaping it by opening up or closing down imaginative possibilities.¹⁰ The prevailing metaphor situates the geopolitical energy futures of South Africa within an intellectual and historical context, necessitating the exploration and experimentation of emerging trends to

9 Andrew Curry and Anthony Hodgson, "Seeing in Multiple Horizons: Connecting Futures to Strategy", *Journal of Futures Studies* (2008): 10.

10 Sohail Inayatullah et al, "Metaphors in Futures Research", *Futures* 84 (2016): 109–114, <https://www.metafuture.org/library/futures-studies/metaphors-in-fr.pdf>.

deepen individual and collective sense-making needed to navigate geopolitical energy futures of South Africa. A representation of the problematic highlights power relations, encapsulating energy colonisation if not disturbed or evoking other areas where alternative power dynamics could play out.

South Africa is in a polycrisis fuelled by energy security uncertainty amid global conflict, increasing global energy demand, tepid global economic growth and increasingly volatile environmental risks

More explicit and direct engagements with the future are needed to overcome used futures. As evidenced in the workshops, feedback loops between material ‘matter’ and ideation are not a linear path but a complex entanglement. Yet there is a reconstructive impulse in alternative futures’ ethical commitment to expanding rather than narrowing futural frames of reference and possibilities. Re-imagining alternative futures moves beyond analysing trends and exploring new technologies as the dominant imaginary theme, coupled with individualistic consumerism. Instead, the value of exploring multiple entry points through scenario development lies in effecting change through progressive social and political experimentation based on public good and common approaches to maturing the relationship between technological and social infrastructures.

Reframing geopolitical energy futures

This section examines alternative framings that inform geopolitical energy futures. These alternative perspectives on human-environment interactions frame how energy development, sustainability and global interactions can shape the future.¹¹ The framings discussed include eco-modernist or post-environmentalist assumptions, planetary stewardship, pathways to sustainability, critical post-humanism, post-growth and the great simplification. There are several approaches to what is meant by a ‘good Anthropocene.’¹² By exploring these framings, policymakers can gain valuable insights into the diverse range of perspectives and approaches that can guide South Africa’s energy policies and decision-making processes.

11 Rika Preiser, Laura Pereira and Reinette Biggs, “Navigating Alternative Framings of Human Environment Interactions: Variations on the Theme of ‘Finding Nemo’”, *Anthropocene* 20 (December 2017): 83–87, <https://www.sciencedirect.com/science/article/abs/pii/S2213305417300474>.

12 The concept of the Anthropocene refers to a new geological epoch characterised by human dominance over Earth’s systems. It signifies a paradigm shift recognising humans impact on Earth systems as a significant geophysical force. Paul J Crutzen and Will Steffen, “How Long Have We Been in the Anthropocene Era?”, *Climatic Change* 61, no. 3 (2003): 251–57, <https://doi.org/10.1023/B:CLIM.0000004708.74871.62>. Crutzen and Steffen.

Framing 1: Ecomodernist or post-environmentalist assumptions

Drawing inspiration from Enlightenment ideals of progress and instrumental rationality, the ecomodernist perspective argues that achieving sustainability is contingent upon embracing human development, modernisation and technological innovation. By harnessing enhanced human agency and implementing strategies such as decoupling, urbanisation, intensified agriculture, aquaculture, desalination and next-generation nuclear power, a balance can be struck between human well-being and sustainable development. The ecomodernist view emphasises the role of human planning and control in managing natural systems, asserting that humanity has the capacity to shape planetary dynamics.

In this vision, a 'good Anthropocene' is characterised by the integration of human progress

In this future, South Africa can contribute to its own economic growth while promoting global sustainability

with effective and responsible strategies for planetary management.

These strategies are to be designed and implemented by humans using their growing social, economic and technological capacities to improve the lives of people, stabilise the climate and protect the natural world. This perspective recognises South Africa's abundant energy resources and expertise as key factors in shaping its energy future and therefore promotes the active deployment of renewable energy, developing infrastructure and advancing technology. In this future, South Africa can contribute to its own economic growth while promoting global sustainability. This framing views South Africa as a significant player in transitioning towards responsible resource management, improving human well-being and protecting the environment.

Framing 2: Planetary stewardship

From this perspective, human well-being is understood to be intricately connected to and dependent on the biosphere, while also acknowledging that humans have become agents responsible for shaping the Earth system on a global scale. The concept of planetary stewardship suggests that navigating the complex social-ecological dynamics of the Anthropocene requires interventions that strengthen humanity's relationship with the biosphere.¹³ It emphasises the development of governance systems capable of addressing

¹³ Carl Folke et al., "Social-Ecological Resilience and Biosphere-Based Sustainability Science", *Ecology and Society* 21, no. 3 (2016), <https://doi.org/10.5751/ES-08748-210341>.

Earth system-scale challenges rather than seeking control over Earth system processes. However, power relations and inequalities in human well-being, particularly between the Global North and Global South, are not explicitly addressed. Technological innovation alone is deemed insufficient for addressing Anthropocene challenges.

Instead, a social-ecological systems perspective highlights the interconnectedness between human agency, well-being and natural systems. In this framing, achieving a 'good' Anthropocene necessitates adaptive governance strategies that recognise and embody humans' responsible relationship as part of and dependent on the biosphere. Pathways to sustainability manifest in emancipatory and social movements that uncover the political nature of dominant governance and innovation patterns. Achieving sustainability in the Anthropocene requires fostering participatory deliberation, allowing diverse perspectives to be heard and represented, contesting existing power structures and sharing responsibility more equitably.

The Planetary Stewardship framing recognises the significant implications for South Africa in geopolitical energy futures. With its rich natural resources and pressing sustainability challenges, South Africa has an opportunity to embrace a stewardship approach to energy development. This perspective highlights the interdependence between human well-being and the biosphere, emphasising the sustainable management of energy resources. By implementing governance systems that prioritise responsible energy practices and incorporate social-ecological considerations, South Africa can play a crucial role in shaping a sustainable and equitable energy future both domestically and globally.

TABLE 3 PROMINENT FRAMINGS OF HUMAN-ENVIRONMENT RESPONSES TO THE GLOBAL ENERGY TRANSITION

Perspective	Underlying worldview and problem framing	Primary response to energy transition in Anthropocene context	Strategies for achieving energy transitions	Examples
Ecomodernist / post-environmentalist	Enhanced human planning and control will better shape planetary dynamics for sustainable use of resources.	Improved human capabilities and technologies to sustainably exploit the natural world.	Renewable energy, developing improved infrastructure and advanced technology.	Decoupling, urbanisation, intensified agriculture, aquaculture, desalination and next-generation nuclear power
Planetary stewardship	Humans are part of and dependent on the biosphere and primarily responsible for its better governance.	Development of governance systems capable of addressing Earth system-scale challenges rather than seeking control over Earth system processes.	Adaptive governance strategies fostering participatory deliberation, allowing diverse perspectives to be heard and represented, contesting existing power structures and sharing responsibility more equitably.	Earth system governance, SDGs, ecosystem goods and services, natural capital accounting

Perspective	Underlying worldview and problem framing	Primary response to energy transition in Anthropocene context	Strategies for achieving energy transitions	Examples
Pathways to sustainability	Multiple, alternative pathways to 'the good' exist. Perspectives of all human communities, especially formerly marginalised perspectives, must be acknowledged.	Shared responsibility and distribution of power promotes pluralities and multiplicities that enable the inclusion of marginalised voices, thus also challenging interventions that overly rely on technological and top-down innovations.	More opportunities for participatory deliberation, allowing diverse perspectives and contexts to be heard and represented.	Participatory deliberation and contestation, political ecology, social movements.
Critical post-humanism	All elements of the biosphere have agency as humans and nature are inseparable.	Centres an ongoing process of reconstituting the world and ourselves, transcending species, space and time.	Fostering inclusive and participatory approaches that consider the interests and well-being of both human and non-human entities.	Non-human agency, relational ethics, Actor-Network Theory.
Post-growth	Economic governance should be informed by ecological stewardship. GDP-growth-aligned economics is inappropriate, especially as a goal for the Global South.	GDP-centred economic growth is de-emphasised in favour of indicators more appropriate to production and consumption, especially in the Global South. Builds alternatives to current unsustainable and unreproducible Western-style economic governance.	Degrowth, agrowth, steady-state economics and post-development	Rebuild village economies with selective technological help; peasant- and artisan-based economies (Gandhian economics); Bhutan's Gross National Happiness index.
The great simplification	At its core, dominant culture has a flawed macroeconomic model, where the dogmatic assumptions about economic growth blinds the true costs of energy consumption amid the limited availability of resources.	Necessitates a significant reduction in societal demand for resources and a fundamental shift in social contracts and governance systems.	Significant reduction in human population to reduce demand for scarce energy resources. Societal changes linked with, decoupling and economic contraction.	Credit decoupling (growth, but with decreasing global credit) including halting all financialisation/creation of financial instruments.

Source: Compiled by authors; based on Rika Preisler, Laura Pereira and Reinette Biggs, "Navigating Alternative Framings of Human-Environment Interactions: Variations on the Theme of 'Finding Nemo'", *Anthropocene* 20 (2017): 83–87.

Framing 3: Pathways to sustainability

The pathways perspective emphasises the importance of exploring alternative pathways to sustainability, especially those that are often marginalised, in contrast to reinforcing the existing dominant approaches. It highlights the significance of power dynamics and inequalities within the current global system. Rather than advocating for a singular transition, this perspective promotes pluralities and multiplicities that enable the inclusion of marginalised voices. It challenges interventions that overly rely on technological and top-down innovations. According to the pathways approach, no definition of what constitutes a 'good' outcome exists. Human agency is situated within emancipatory and social movements that aim to reveal the political nature of prevailing governance forms and innovation patterns.¹⁴ Achieving sustainability in the Anthropocene requires creating more opportunities for participatory deliberation, allowing diverse perspectives and contexts to be heard and represented. This process fosters contestation and ensures shared responsibility and distribution of power.

According to the pathways approach, no definition of what constitutes a 'good' outcome exists

The Pathways to Sustainability framing presents transformative implications for South Africa in geopolitical energy futures. The perspective would involve a critical examination of power dynamics, amplifying marginalised voices and promoting participatory decision-making processes that incorporate diverse perspectives in South Africa and SADC. By engaging in emancipatory and social movements, South Africa can contribute to reshaping governance interests and motivations towards sustainable energy practices. This framing recognises the importance of addressing social, economic and political dimensions while redistributing responsibility and benefits for a just and equitable energy future.

Framing 4: Critical post-humanism

Grounded in a relational understanding of human-nature inseparability, the critical post-humanist paradigm asserts that all phenomena are interconnected and distinctions arise based on the relationships within an infinite web of connections.¹⁵ According to this perspective, agency is not exclusive to humans but extends to nature, non-human entities and events. The interplay of various actors within networks determines subjectivity

14 Andy Stirling, "Emancipating Transformations: From Controlling 'the Transition' to Culturing Plural Radical Progress", in *The Politics of Green Transformations* (STEPS Working Paper 64, STEPS Centre, Brighton, 2014): 54–67.

15 Rosi Braidotti, *The Posthuman* (Cambridge and Malden: Polity Press, 2013).

and otherness, shaped by power structures and actions. Transitioning to sustainable futures goes beyond human-centric approaches and involves an ongoing process of reconstituting the world and ourselves, transcending species, space and time. In this framework, sustainable responses in the Anthropocene empower a web of relations, acknowledging agency at multiple levels of existence.¹⁶ Responsibility for shaping conditions conducive to ‘multispecies flourishing’ rests upon all ‘earthlings,’ be they human or non-human.

According to this perspective, agency is not exclusive to humans but extends to nature, non-human entities and events

The critical post-humanism framing holds profound implications for South Africa and beyond in geopolitical energy futures. It challenges traditional human-centric approaches and emphasises the interconnectedness and agency of all entities within ecosystems. This perspective questions human privilege and promotes the acknowledgement and empowerment of diverse relationships and actors in shaping sustainable futures. By fostering inclusive and participatory approaches that consider the interests and well-being of both human and non-human entities, South Africa can contribute to a more balanced and sustainable coexistence in the Anthropocene era.

Framing 5: Post-growth

The Post-Growth framing advocates moving beyond the focus on economic growth and replacing GDP with comprehensive indicators to guide production and consumption. It encompasses four interconnected perspectives: degrowth, agrowth, steady-state economics and post-development.¹⁷ Degrowth calls for localised and equitable economies, shifting away from resource-intensive energy practices. Agrowth challenges the reliance on GDP growth, defining well-being and sustainability independently of market-based expansion. Steady-state economics promotes non-growing societies with stable material and energy throughput, guiding policies towards a balanced and sustainable energy landscape. Post-development challenges the dominant narrative of Western-centric development, fostering culturally-specific concepts of the ‘good life’ and community-based economies.¹⁸ Embracing these interconnected perspectives enables South Africa

16 Donna J Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham: Duke University Press, 2016).

17 Tim Jackson, “The Post-Growth Challenge: Secular Stagnation, Inequality and the Limits to Growth”, *Ecological Economics* 156 (1 February 2019): 236–46, <https://doi.org/10.1016/j.ecolecon.2018.10.010>.

18 Julien-François Gerber and Rajeswari S. Raina, “Post-Growth in the Global South? Some Reflections from India and Bhutan”, *Ecological Economics* 150 (August 2018): 353–58, <https://doi.org/10.1016/j.ecolecon.2018.02.020>.

to transition towards a more sustainable energy future prioritising social well-being, environmental stewardship and alternative economic models.

Framing 6: The great simplification

The Great Simplification framing challenges and assumptions ingrained in global culture regarding energy and economic growth. It highlights the blind spot in our understanding of the true costs associated with energy consumption and the limited availability of resources. By recognising the geological time and effort required to process and refine our main input, this reframing urges a re-evaluation of global assumptions and the environmental costs of energy production and consumption. On a global scale, the combination of mindless behaviour, insatiable energy consumption and excessive carbon dioxide emissions has given rise to a collective entity Hagens calls 'the Superorganism.'¹⁹ Taking a systems-thinking perspective, this Superorganism is driven by the relentless pursuit of growth, even as we face limitations imposed by this pattern of behaviour. In our efforts to evade this reality, the Superorganism creates an ever-widening gap between embedded financial constructs and the confronted physical realities.

The impending moment of reckoning holds the potential to be a pivotal time for global and South African culture, serving as a catalyst for the emergence of a new paradigm known as 'systems economics' and ushering in alternative ways of living. This perspective promotes engagement in a conversation that transcends individual interests and encompasses the collective fate of our species. It questions the sustainability of indefinite economic growth and calls for throttling down the global metabolism driven by fossil fuels. This framing also questions the feasibility of fully replacing fossil fuels with renewable technologies, necessitating a significant reduction in societal demand for resources and a fundamental shift in social contracts and governance systems. This emphasises the need to let go of growth and consumption to benefit future ecosystems, lives and human economies while fostering a more sustainable and resilient future.

These framings challenge conventional assumptions and highlight the normative ethical choices at hand

The exploration of the six framings that inform the future of energy geopolitics presents policymakers with a wealth of alternative perspectives and approaches. These framings challenge conventional assumptions and highlight the normative ethical choices at

¹⁹ N.J Hagens, "Economics for the Future – Beyond the Superorganism", *Ecological Economics* 169 (March 2020): 106520, <https://doi.org/10.1016/j.ecolecon.2019.106520>.

hand. This emphasises the need for futures thinking and complex adaptive systems thinking in decision-making processes. As policymakers navigate the complexities of energy transitions, it is crucial to consider the principles outlined in the UN's Our Common Agenda.²⁰ These principles advocate for intergenerational fairness and the well-being of future civilisations. By applying futures thinking, policymakers can anticipate potential long-term impacts and uncertainties associated with different policy options. It requires recognising the interconnectedness within complex systems, including social, economic and environmental factors. Such an approach acknowledges the need to go beyond short-term gains and consider broader implications for sustainability, social equity and environmental stewardship.

It calls for inclusive, networked and effective multilateralism to respond better and deliver for people and the planet

Moreover, incorporating principles of intergenerational fairness and the interests of future civilisations into policy decisions is essential. The choices made today will have long-lasting consequences for future generations and non-human others. By prioritising the well-being and rights of future populations and a multi-species planet, decision makers can foster a more just and equitable energy future. This involves re-evaluating prevailing growth-centric economic models and embracing framings that emphasise inclusive governance, environmental sustainability and social equity. Informed by the six framings, policymakers have an opportunity to shape energy policies that align with the principles of Our Common Agenda, which is the UN Secretary-General's vision²¹ for the future of global cooperation. It calls for inclusive, networked and effective multilateralism to respond better and deliver for people and the planet. The goal is to get the world back on track by turbocharging action on the SDGs.

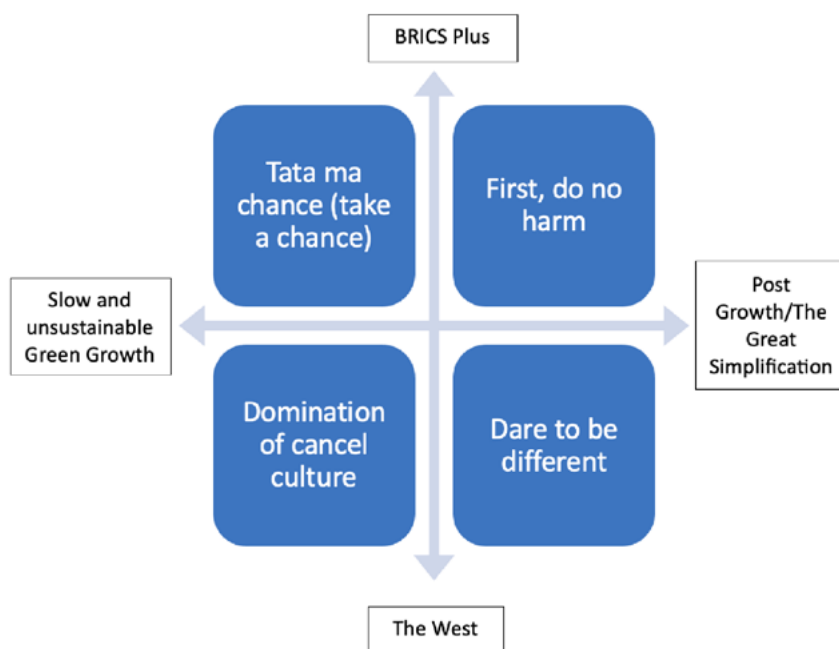
20 UN, "Our Common Agenda", UN, <https://www.un.org/en/common-agenda>.

21 UN, "Secretary-General's Report on 'Our Common Agenda'", <https://www.un.org/en/content/common-agenda-report/>.

Emerging scenarios for the future of energy geopolitics in South Africa by 2050

Jim Dator’s four futures framework,²² also known as the four archetypes of the future, provides different scenarios for envisioning possible futures. The framework helps consider a broad range of possible futures beyond the conventional dichotomy of utopian versus dystopian scenarios. It encourages thinking about multiple dimensions of the future, such as social, technological, environmental and political factors. This comprehensive exploration helps in avoiding simplistic or linear thinking about the future and enables a more nuanced understanding. Using the contributions of the stakeholders in the workshop, key factor-based scenario techniques were applied, namely the creative narrative method through intuitive logic. The four scenarios illustrate different potential pathways for the geopolitical energy futures for South Africa in 2050, considering factors such as economic growth, resource availability, governance and sustainability. The intention is not to predict the future but to illustrate how critical key uncertainties could interplay, resulting in alternative futures.

Figure 1 Scenario matrix of emerging scenarios of geopolitical energy futures in South Africa by 2050



Source: Compiled by the authors

22 Jim Dator, “Alternative Futures at the Manoa School”, *Journal of Futures Studies* 14, no. 2 (2009), <https://fsdigital.org/articles-and-essays/2009-2/vol-14-no-2-november/articles/futuristsalternative-futures-at-the-manoa-school/>.

Scenario 1: First, do no harm

A retrospective view of 2023, from the vantage point of 2050: major foundational geopolitical shifts, which occurred as the BRICS countries increased in membership and size, were transformative for the global landscape. With the BRICS bloc contributing more than 50% of global GDP, it became the biggest and most empowered geopolitical bloc, positioning itself as an alternative to the Global North and the West. BRICS+ successfully expanded its influence, redefining perspectives on socio-ecological responsible lifestyles within planetary boundaries, emphasising private sufficiency and comfort while respecting the Earth's limits.

To achieve this vision, the BRICS+ bloc established a Global South Earth Commission, implementing guidelines for waste reduction, pollution control and emissions reduction for both corporations and individuals. This shift in cultural values and economic models aimed to create intergenerational fairness and ensure a liveable planet for future generations. As part of the new paradigm, the BRICS+ bloc focused on collaboration and complementarity rather than militarism and competition. The emphasis shifted towards practicality and realism, promoting private sufficiency and caring societies. This led to innovations in the heating, cooling and transportation sectors, with new technologies fostering energy-efficient low-tech designs and high-tech solutions that offered public luxury while minimising environmental impact.

Architectural designs and construction incorporated decentralised heating and energy systems, moving away from the traditional one-size-fits-all approach. Instead, buildings were tailored to meet specific heating needs while reducing overall energy waste through individual space heaters, radiant floor heating, heated clothing and solar-powered heating solutions.

The BRICS+ bloc, along with its additional partners, recognised the limits of infinite growth on a finite planet and repositioned its resources accordingly. They transitioned towards regenerative economies by extending and reusing existing infrastructures, reducing energy and material demands. This approach fostered increased interactions among people, reducing loneliness and positively impacting mental health.

Precautionary measures were proactively implemented to manage material and energy flows, leading to the emergence of new economies based on sharing infrastructures. Social and civic technologies played a crucial role in supporting the regenerative economy, providing access and self-governance to shared assets and improving governance with joint investments.

The transformation extended to the finance sector, transitioning from greed-driven finance to transparent stewardship finance models. This shift promoted positive spillovers from the regenerative economy, including greater reliance on ecological services, improved health, reduced material and energy consumption, sustainable mobility options and contributions to electrification networks.

Overall, the BRICS+ bloc's vision and proactive measures set the stage for a more sustainable and equitable global future, with a focus on responsible corporations, circular economies and durable well-being-oriented practices. The transition towards circular and regenerative designs and a shift in labour economics ensured a prosperous and sustainable future for generations to come.

Scenario 2: Tata ma chance (take a chance)

Looking back at 2023 in 2050: the BRICS bloc grew, but building regenerative economies instead of extractive ones was still a work in progress. Within BRICS+, factions emerged, with a large majority resorting to greenwashing and remaining focused on extractive methods to fuel economic growth, although pockets of green growth were visible. The dominant measure of economic prosperity still centred around personal income and moving people from low- to middle- to high-income status. Systemic innovations and alternative financial models were relatively rare, with little interest in developing nature-based solutions and climate-resilient infrastructure.

Cities that embraced green and blue infrastructures, incorporating urban forests and water surfaces while reimagining mobility, experienced a rapid rise in urbanisation and functioned as systemic cooling systems, significantly reducing climate change disasters. Advances in agri-tech and the adoption of precision farming led to a decreased reliance on imports, promoting self-reliance and shorter supply chains. Societal infrastructure technologies were integrated, leveraging low-tech ecological innovations, civic tech and machine learning to reduce input costs and enable better decision-making, resulting in higher crop yields and improved margins for farmers. This also made better quality food more accessible, reducing strain on healthcare systems.

Unfortunately, most countries in the BRICS+ bloc resorted to greenwashing, implementing marginal climate adaptation and mitigation innovations to existing production, consumption and green growth practices. While these efforts slightly reduced the devastating impacts of climate change, they lacked the leadership and vision needed to transition fully into the regenerative economy era. Decision-making models continued to prioritise short-term gains, neglecting the long-term environmental implications and the welfare of future generations. A few countries within the bloc were driven by Western principles, relentlessly pursuing economic growth regardless of consequences.

The short-lived economic gains made by the greenwashed green growth economy were overshadowed by new and unforeseen costs, such as mitigating overheating in cities and coping with increased frequency and severity of droughts, fires and floods. This faction in the BRICS+ bloc faced an ultimatum due to significant economic losses and their reluctance to move beyond fossil fuels and the extractive economy. They failed to embrace the regenerative economy and became ecological burdens on the geopolitical bloc.

To prevent mass migration to countries adopting regenerative practices, more aggressive place-based regulatory sandboxes were deployed in the faction countries, encouraging pockets of radical innovation to facilitate transitions towards post-growth models. This endeavour was supported by increased dialogue, collaboration and advocacy by a vibrant, youthful population. However, the missed opportunities to proactively address the challenges of the early 2020s left many citizens in the BRICS+ bloc vulnerable to multiple crises.

Scenario 3: Cancel culture dominance

In 2023, the West, represented by the US and Europe, was gripped by a fear of losing power in a multipolar world and continued to cling to traditional economic models. In contrast, the BRICS+ bloc displayed the capacity to embrace new types of operations and agencies that valued spillover effects and shared benefits. However, the West remained entrenched in imperialist mindsets, still practising neo-colonialisation, where extraction and exploitation for economic gains persisted despite surface-level rhetoric attempting to counter these narratives. The West was unable to adopt practices of the regenerative economy despite these being massively popular with its citizens. Instead, the West created newly formed alliances with sovereign nations claiming to implement post-growth strategies, yet in practice remained tied into fossil fuel systems and the green growth approach.

The values of green growth and economic expansion continued to be the driving forces behind the West's economic policies. It clung to the belief that so-called economic prosperity derived from unchecked growth. Investment rewards from public or private institutions were skewed, cutting deep into human development funds. These lopsided agreements, heavily favouring the West, made it nearly impossible for African economies to provide socio-economic well-being to their citizens.

The financial might of the West allowed it to wield sanctions against countries not aligned with its economic principles and aspirations. Instead of collaborating with the BRICS+ bloc to prepare for a post-growth economy collectively, the West heavily invested in research and development to implement new methods that supposedly promoted economic prosperity with reduced environmental impact.

The ageing population in developed economies strained economic growth, forcing the West to reconsider its insular approach. It began considering revoking sanctions and preferential trade practices to be part of the regenerative economy. This set the stage for ecological reparation negotiations between the BRICS+ countries and the West. These negotiations transcended computational bureaucracy, focusing instead on the value across flows rather than just the balance sheet. This approach opened opportunities to address and account for a multi-stakeholder worldview, embracing economies of care for humans and the environment and exploring multi-currency trade to build more resilient economic value. This resulted in the development of multi-beneficiary frameworks rooted in mutual care, respect and tolerance.

Scenario 4: Dare to be different

Finally, reviewing 2023 through a future perspective in 2050: the West decided to take the lead away from China in driving the demand and supply of critical minerals within the extractive economy. With the growing realisation of the realities of climate change and the limits to growth, years of research and development innovations finally brought about a transformational era. People began living closer to their natural habitats and the era of excess, high private luxury and conspicuous consumption became a distant memory. This shift in mindset gave rise to new human values, emphasising collaboration across complexities for the betterment of society. Engaged civic organisations played a pivotal role in spearheading the development of the post-neo-colonial, regenerative economy.

The West leveraged collective privilege to pioneer planetary peace through the promotion of the regenerative economy while staying within planetary and environmental boundaries. Collaborating with the BRICS+ countries, the West worked to promote innovative capacities across all sovereigns, preparing for contextually appropriate economic models for sectors that require growth, agrowth, degrowth and post-growth. This led to a truly democratic and inclusive approach to human-nature relations, respecting the non-human other.

Geopolitics underwent an innovative agility test as cross-sectoral alliances were formed to swiftly and effectively leverage new solutions at scale for the ushering in of the new era. The West increased its focus and funding to demonstrate the capacities needed to transition to new markets, ways of living and transacting. Leadership became crucial in moving beyond merely reacting to market dynamics to delivering structural reforms that reimaged the meaning of geopolitics in a post-growth world.

Addressing inequalities, particularly in the BRICS+ countries, demanded a fresh policy logic to counter rising poverty levels and urgent economic needs, especially in mineral-rich nations. To support the regeneration economy in a post-growth era, significant investments were made in next-gen financial institutions that developed alternative economic models. These institutions focused on the redistribution of scarce resources, such as minerals and energy, to support a scaled and urgent transition towards a more sustainable future.

Conclusion

As we conclude our in-depth exploration of the critical minerals landscape in Southern Africa and its profound implications for South Africa's geopolitical energy transition by 2050, we are left with a comprehensive understanding of the challenges, opportunities and transformative potentials that lie ahead. This research has brought to light the intricate interplay between resource abundance, sustainable energy development and global dynamics. With this knowledge in hand, we stand at a crucial juncture, equipped to formulate pragmatic and impactful recommendations that can shape South Africa's energy future.

The implications of this research resonate across multiple dimensions, bearing far-reaching consequences for Southern Africa's energy landscape, international relations and environmental sustainability. The imperative to balance economic development with responsible resource management requires a nuanced approach that transcends conventional paradigms. Alternative framings, such as ecomodernism, planetary stewardship, pathways to sustainability, critical post-humanism, post-growth and the great simplification, highlight the diversity of perspectives that inform policy decisions. Each framing holds the potential to shape the trajectory of South Africa's energy transition, yet discerning the most effective path forward demands a pragmatic evaluation of their implications.

Drawing from the wealth of insights garnered through our research, we present a set of recommendations that stand as a beacon for policymakers navigating South Africa's geopolitical energy transition by 2050.

- Building awareness of energy futures framings: Embrace an integrative approach that harmonises elements from multiple framings. Recognise the value of ecomodernist, pathways to sustainability and post-growth and the great simplification ideals in driving technological innovation and sustainable development, while also incorporating the ethos of planetary stewardship to ensure responsible resource management and intergenerational equity. Such a synergistic approach bridges economic imperatives with environmental responsibility.
- Transparency and collaboration: Foster transparent collaboration with BRICS+ nations and global stakeholders to harness the potential of critical minerals while prioritising equitable distribution of benefits. Engage in robust dialogue to develop cooperative frameworks that transcend extractive practices, laying the foundation for a regenerative economy based on shared values.

- **Education and awareness:** Invest in educational initiatives that promote a holistic understanding of the intricate interplay between critical minerals, energy transition and sustainability. Empower citizens with knowledge to advocate for responsible policies and promote active participation in shaping the energy landscape.
- **Innovation and diversification:** Champion research and innovation in energy technologies that reduce reliance on finite resources and promote renewable alternatives. Support diversification of the energy mix to reduce vulnerabilities and enhance energy security while minimising environmental impact.
- **Policy flexibility:** Craft policies that remain adaptive to evolving geopolitical and environmental dynamics. Incorporate pathways to sustainability by acknowledging the importance of marginalised voices and inclusive decision-making processes, allowing policies to be resilient in the face of uncertainty.
- **Economic paradigm shift:** Embrace the principles of the great simplification to challenge prevailing growth-centric economic models. Encourage the transition to post-growth economies that prioritise well-being, resource stewardship and non-material values, ensuring a sustainable and equitable future.
- **Multilateral cooperation:** Advocate for inclusive and networked multilateralism, as outlined in Our Common Agenda. Engage in international collaborations that prioritise intergenerational fairness, environmental responsibility and the well-being of future civilizations.

These recommendations are the culmination of a meticulous examination of evidence, perspectives and potential consequences. The integration of diverse framings, transparent collaboration, innovation and a shift in economic paradigms will pave the way for South Africa's successful energy transition by 2050. By taking bold action today, countries can lay the foundation for a more sustainable, equitable and resilient energy landscape that benefits not only our current generation but also those that will inherit the world.

The integration of diverse framings, transparent collaboration, innovation and a shift in economic paradigms will pave the way for South Africa's successful energy transition by 2050

In the face of global challenges and the urgency of environmental stewardship, the path forward is clear. Policymakers, stakeholders and global citizens must collectively seize this opportunity to navigate Southern Africa's geopolitical energy transition with wisdom, foresight and the determination to forge a better future for all. The journey may be complex, but the destination is resolute – a future where responsible resource management, environmental sustainability and equitable prosperity converge to define the legacy of our generation.



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