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The Role of State-Owned Enterprises (SOEs) in Advancing a Just Energy Transition in South Africa

Jonase Nthunya, Trynos Gumbo, Retsepile Kalaoane, Siphiwe Mbatha

(Jonase Nthunya, University of Johannesburg, Department of Urban and Regional Planning, Johannesburg, South Africa; nthunyanthunya1992@mail.com)
(Trynos Gumbo, University of Johannesburg, Department of Urban and Regional Planning, Johannesburg, South Africa; tgumbo@uj.ac.za)
(Retsepile Kalaoane, University of Johannesburg, Department of Urban and Regional Planning, Johannesburg, South Africa; tshepytoya20@gmail.com)
(Siphiwe Mbatha, University of Johannesburg, Department of Urban and Regional Planning, Johannesburg, South Africa; gmbatha@uj.ac.za)

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1 ABSTRACT

South Africa's transition to a low-carbon energy system is essential to combat climate change and reduce reliance on fossil fuels. Given coal's dominance, State-Owned Enterprises (SOEs) such as Eskom and SANEDI are key to guiding an inclusive, sustainable transition. This study, based on collaborative planning and conflict management theories, views JET as a multi-actor governance process. It explores PPP models to attract investment and foster social inclusion. Using qualitative methods, including institutional analysis and bibliometric mapping, the research identifies policy progress and ongoing challenges, including infrastructure issues, fragmented coordination, gaps in community engagement, and difficulties with technology integration. The study proposes a SOE-focused Just Energy Transition Framework, highlighting stronger PPPs, participatory planning, accountability, and conflict-sensitive governance as essential for meeting climate goals and ensuring social and economic equity.

Keywords: Climate Change, State Owned Enterprises, Just Energy Transition, Fossil Fuel Dependence, Public Engagement

2 INTRODUCTION

Energy production from fossil fuels remains a primary driver of global climate change (Liu and Wang, 2025). Rising carbon dioxide (CO_2) emissions have led to record increases in global surface temperatures, intensifying environmental degradation and socio-economic vulnerabilities (Kabir et al., 2023; Zhang, 2024). Urbanization further compounds these challenges: while it accelerates economic growth and innovation, it simultaneously contributes to ecological deterioration through rising energy consumption in transportation, industries, and buildings. Indeed, urban activities account for nearly 70% of global energy-related carbon emissions (Tong et.al, 2025). In many regions, particularly in Africa, continued reliance on traditional biomass such as wood and charcoal undermines health, livelihoods, and environmental sustainability (Njenga et al., 2022).

Mgwangi et. al 2023 state that ensuring equitable access to modern energy is critical for both poverty alleviation and long-term development. Yet South Africa faces a complex dual challenge, which includes meeting increasing energy demand while tackling ongoing supply shortages and reducing climate risks. Since 2007, insufficient generation capacity has caused widespread disruptions, resulting in prolonged daily blackouts in 2023 (Molepo, Aboalez and Mathaba, 2025). These crises reveal deep institutional and infrastructural weaknesses and underscore the urgency of transitioning toward renewable and sustainable energy sources such as solar, wind, hydropower, and geothermal.

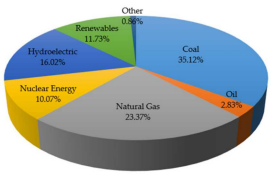

Figure 1: World electricity mix by source (Supapo 2021)

Globally, economic development and population growth continue to be supported largely by carbon-intensive energy systems, with fossil fuels dominating electricity generation, underscoring the persistent reliance on unclean energy sources and the urgent need for a cleaner and more sustainable global energy mix. Figure 1 shows the global electricity mix, with coal (35.12%) and natural gas (23.37%) dominating.

Fossil fuels collectively generate over 60% of electricity, underscoring their significant contribution to Carbon dioxide emissions and climate change. Low-carbon sources, renewables, hydro, and nuclear, remain comparatively small, highlighting the gap in meeting global climate targets (Supapo, 2021). This dominance of fossil fuels in the global electricity mix implies an urgent need to reorient urban development pathways towards low-carbon and energy-efficient models, integrating renewable energy systems alongside green and blue infrastructure frameworks to decouple economic growth from carbon emissions and align with global climate targets.

The notion of a just energy transition emphasizes that decarbonization must extend beyond climate objectives to integrate equity, inclusivity, and social justice. In South Africa, this imperative is particularly urgent given the legacy of apartheid, where a fossil-based energy system entrenched social and environmental injustices (Annecke, 2012; Magazzino et al., 2020). Communities dependent on coal economies risk being disproportionately affected by the transition unless deliberate safeguards, redistribution mechanisms, and participatory governance processes are implemented.

At the global level, the 2015 Paris Agreement reaffirmed the urgency of reducing carbon emissions, yet coal still accounted for more than one-third of global electricity generation as recently as 2021 (United Nations, 2015; Todorov et al., 2024). For South Africa, where coal dominates the energy mix, achieving a just energy transition requires not only technological innovation but also institutional reform. In this regard, state-owned enterprises (SOEs), most notably Eskom, the country's largest electricity utility, and the South African National Energy Development Institute (SANEDI), play a pivotal role. With mandates to provide public goods, these SOEs are uniquely positioned to shape investment patterns, enable renewable energy integration, and ensure that the transition delivers both environmental sustainability and social equity.

This study, grounded in collaborative and advocative planning theory and informed by conflict management perspectives, conceptualizes the Just Energy Transition (JET) in South Africa as a negotiated, multi-actor governance process. Focusing on Eskom and SANEDI, it addresses fragmented literature on how SOEs navigate trade-offs between energy security, climate action, and social justice. A systematic review and bibliometric analysis synthesize existing studies, identify knowledge gaps, and highlight persistent SOE challenges, including infrastructural constraints, limited coordination, uneven renewable energy integration, and weak community engagement. The study proposes a practical SOE-centred JET Framework emphasising participatory planning, strengthened PPPs, institutional accountability, and conflict-sensitive governance to advance socially equitable, economically inclusive, and climate-aligned energy futures.

3 METHODOLOGICAL CONSIDERATIONS

This study adopts a mixed-method systematic review, integrating both qualitative and quantitative techniques to examine the role of SOEs in advancing a just energy transition in South Africa. The methodology combines systematic literature review, bibliometric analysis, and empirical data analysis.

3.1 Systematic Literature Review

A systematic literature review was conducted using Scopus-indexed articles, following the PRISMA protocol, to capture scholarly insights into SOEs, just energy transitions, and energy governance. The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement, published in 2009, was designed to help systematic reviewers transparently report why the review was done, what the authors did, and what they found (BMJ, 2021). Scopus was chosen for its comprehensive coverage of peer-reviewed literature across multiple disciplines, high-quality indexing standards, and advanced search functionalities, which enable a systematic, transparent, and reproducible approach to literature retrieval. The review focused on publications from 2015 to 2025 and covered subject areas including the social sciences, energy, environmental science, and the humanities. The review aimed to identify trends, knowledge gaps, and evidence supporting the role of SOEs in the energy transition.

Procedure:

(1) Keywords: "just energy transition" AND "South Africa" – 40 documents retrieved (limited to 38 relevant publications after screening).

(2) Keywords: "state-owned enterprise" AND "South Africa" AND "energy" – 13 relevant documents retrieved.

(3) Keyword: “Collaborative Planning” AND “Advocative Planning”

3.2 Bibliometric Analysis

Bibliometric Analysis of Learning Models Research Using Vosviewer (Nova et al., 2023). Bibliometric analysis was conducted using VOS viewer software to visualize research patterns, including knowledge clusters, keyword co-occurrence, and trends in the literature. To ensure data quality, PRISMA Protocol was used. Moher 2010 states that PRISMA Statement is to help authors improve the reporting of systematic reviews and meta-analyses. This analysis identified critical research gaps and emerging areas of inquiry related to just energy transitions and the role of SOEs in South Africa.

3.3 Thematic Data Analysis

Thematic Analysis (TA) is one of the most widely utilized methods for analyzing qualitative data, offering a structured yet flexible framework for identifying, analyzing, and interpreting patterns of meaning within datasets (Ahmed et al., 2025). For this study, thematic synthesis is applied to identify recurring themes, such as the challenges faced by South African SOEs, including Eskom and SANEDI, in implementing a Just Energy Transition.

3.4 Study Area

The study area for this research is South Africa (Figure 2). South Africa offers a unique context for examining the Just Energy Transition due to its position as Africa’s largest economy and its relatively advanced institutional and planning systems.

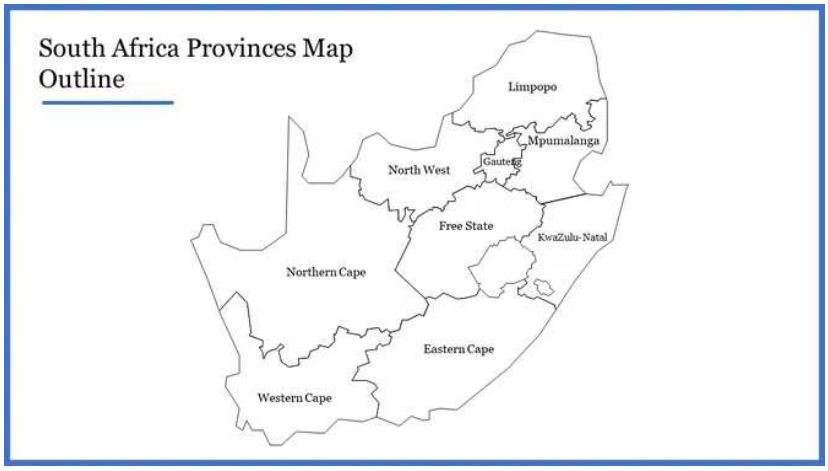

Figure 2: Map of South Africa

The country’s coal-dominated energy sector, combined with its cultural diversity and historical inequalities, presents complex social, economic, and technical challenges for energy transition. Examining the role of SOEs in this context provides practical insights into how state-led institutions can manage these challenges, and the lessons learned can inform energy transition strategies in other African countries and the broader Global South.

3.5 Rationale for Methodology

A convergent mixed-methods approach was selected to triangulate evidence from multiple sources, enabling a comprehensive understanding of both theoretical and practical dimensions of the Just Energy Transition. By integrating quantitative bibliometric analysis with qualitative thematic synthesis, the study captures both publication trends, key actors, and research networks as well as insights into challenges, opportunities, and governance practices of SOEs. This approach strengthens the validity and reliability of the findings, ensures a holistic perspective, and addresses the fragmentation of the existing literature on state-led energy transitions in South Africa.

4 RESULTS AND DISCUSSIONS

4.1 Energy Justice and Just Transition

A just energy transition refers to the shift from fossil fuel–based systems to sustainable and renewable energy sources in a fair and inclusive manner (Ndlovu, 2025). At the heart of this is the principle of energy justice, which emphasizes equity, fairness, and ethics in energy governance, ensuring that low-carbon transitions redress historical inequalities and place marginalized groups at the center (Taghizadeh-Hesary et al., 2021). Across Africa, where millions still lack access to modern energy, energy justice is a cornerstone of sustainable development (Abe & Azubike, 2025). In South Africa, high electricity costs compel many households to rely on unsafe and polluting fuels, intensifying health risks and environmental degradation. Achieving a truly just transition, therefore, requires providing affordable, reliable, and clean energy for all.

Globally, coal-fired power remains the dominant source of electricity and a major contributor to carbon dioxide emissions (EIA, 2019), driving international commitments such as the UN's Sustainable Development Goal 7, which calls for universal access to clean and affordable energy (UNDP, 2019). However, despite South Africa's abundant wind and solar resources, renewable energy uptake has been sluggish, leaving coal entrenched as the backbone of the energy system and perpetuating socio-environmental vulnerabilities (Molepo et al., 2025). Addressing these challenges demands not only technical solutions but also institutional reforms, particularly through State-Owned Enterprises (SOEs), whose governance frameworks critically shape access, affordability, and the pace of South Africa's clean energy transition.

4.2 State-Owned Enterprises and Governance

State-owned enterprises (SOEs) have traditionally played a key role in infrastructure and service provision across sectors such as energy, water, and transportation (Ferdiana & Sugiyarto, 2022). Globally, SOEs are increasingly acknowledged as important players in sustainability transitions because of their presence in energy-producing and energy-intensive industries (Curi et al., 2025; Meelen & Sluijs, 2025). However, their contribution to energy transitions, particularly in emerging economies, remains underexplored (Zhu et al., 2023). The origins of SOEs are connected to evolving political-economic paradigms since the 1970s, influenced by neoliberal reforms and state interventions (Harvey, 2005; Papenfuß, 2014; Lee et al., 2022). Although they were intended to improve efficiency, productivity, and service delivery, many SOEs encounter governance issues, political interference, and fiscal challenges (Mbo & Adjasi, 2017). In South Africa, these issues are especially acute in the energy sector.

Figure 3: Hendrina Power Station (Eskom, 2025)

4.3 South Africa's Energy Landscape

South Africa generates over 80% of its electricity from coal, making it one of the world's top ten greenhouse gas (GHG) emitters (Fitzgerald et al., 2024; Akinbami et al., 2021). Eskom, the national power utility, is responsible for more than 90% of electricity production and contributes about 45% of Africa's total

electricity generation capacity. It ranks among the world's top 20 utilities by size. However, its reliance on coal has entrenched environmental and climate challenges.

Eskom's operational difficulties, including rising debt, mismanagement, corruption, ageing infrastructure, coal shortages, and frequent load shedding, have severely undermined energy security and economic stability (Pramjeeth, 2021; Eskom, 2022). These failures highlight the urgent need for reform.

Figure 3 shows an example of a large Eskom power station used for electricity generation, which has negative environmental impacts.

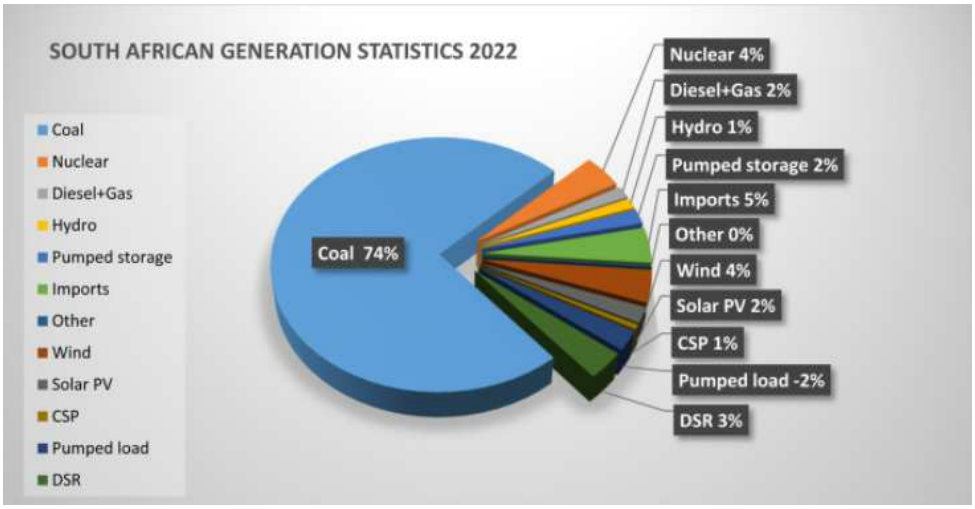

Figure 4: South African Energy generation distribution (Ndlovu, 2025)

Figure 4 illustrates South Africa's energy generation profile, showing its continued heavy reliance on coal and highlighting the role of state-owned enterprises, such as Eskom and SANEDI, in facilitating a Just Energy Transition. Despite global shifts toward cleaner energy in line with the United Nations Sustainable Development Goals, coal remained the dominant energy source in South Africa in 2022, emphasizing the urgent need for a shift to sustainable alternatives. Across the African continent, energy is produced from diverse sources, including oil, coal, wind, solar, geothermal, hydro, and natural gas, with countries such as Zambia, Mozambique, Madagascar, Tanzania, and the Democratic Republic of Congo generating a substantial share of electricity from renewable sources (IRENA, 2021).

4.3.1 ESKOM

According to the Constitution of the Republic of South Africa (1996), the allocation of certain public goods and services to State-Owned Enterprises (SOEs) is mandated to benefit citizens, subject to the availability of financial resources (Mashilo & Kgobe, 2024). However, South Africa's energy capacity has been negatively impacted by an inadequate, unreliable, and unpredictable electricity supply (Eskom, 2022). As a result, Eskom, the national electricity utility, has become both a key part of the country's economic activity and a symbol of its systemic energy challenges. Eskom plays a significant role across the African continent, contributing approximately 45% of Africa's electricity generation and ranking among the 20 largest utilities worldwide by generation capacity. Despite this scale, most of its electricity is generated from coal, making South Africa one of the top ten global emitters of greenhouse gases (GHG) (Akinbami et al., 2021). This dependence on coal presents a major obstacle to the country's decarbonisation and just energy transition agenda.

Scholars have noted that SOEs such as Eskom impose unnecessary financial burdens on governments by increasing taxes and inefficiencies (Nhleko & Inambao, 2021). Eskom faces numerous difficulties, including rising debt, mismanagement, governance issues, coal shortages, labor unrest involving infrastructure damage, poor staff performance, and aging power plants. These problems lead to frequent load-shedding, higher operational costs, and concerns over the utility's long-term viability (Pramjeeth, 2021). To address these issues and align with South Africa's Just Energy Transition (JET) goals, Eskom has initiated several reforms (Msimango and Orffer, 2022). These include breaking the utility into separate generation, transmission, and distribution units to enhance efficiency and accountability, as well as encouraging private sector involvement in renewable energy projects (Kemabonta, 2025). Eskom also plays a central role in

implementing the Just Energy Transition Investment Plan (JET-IP), aiming for "Net Zero" carbon emissions by 2050 (Steed et al., 2025), focusing on attracting public and private investments to shift from coal to cleaner energy sources, support affected workers, and promote social and economic inclusion (Karg et al., 2025). These energy reforms demonstrate a strategic effort to stabilize electricity supply while supporting a socially just and environmentally sustainable energy transition in South Africa (Mirzania et al., 2023).

4.3.2 SANEDI

The South African National Energy Development Institute (SANEDI) is a government research agency tasked with advancing energy innovation, technology development, and policy support across the renewable, bioenergy, fossil-based, and energy-efficiency sectors to promote sustainable and secure energy systems (Academy of Science of South Africa, 2014). SANEDI is a South African state-owned entity that conducts energy research, development, and innovation, and promotes energy efficiency. It supports the country's energy transition by optimizing energy resource use, developing technologies, building capacity, and providing advice, funding, and technology transfer across the energy sector (HSRC, 2022). Therefore, it is quite notable that, Complementing Eskom, the South African National Energy Development Institute (SANEDI) plays a more specialized role in research, innovation, and piloting renewable projects. Policy frameworks such as the Integrated Resource Plan (IRP) and the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) have created opportunities for renewable expansion, though implementation has been uneven (Eberhard et. al 2016).

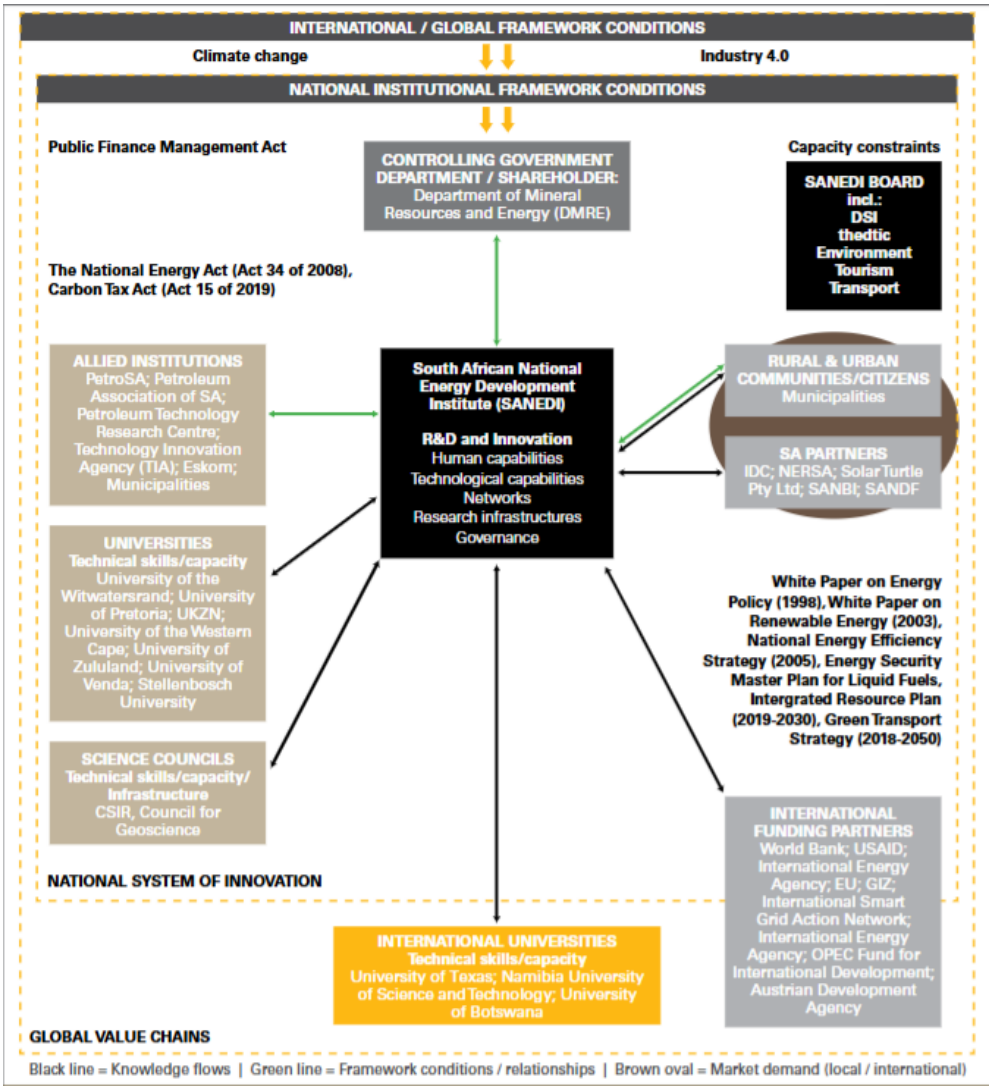

Figure 5: An illustrative mapping of the sectoral R&D and innovation system (HSRC, 2022)

4.4 Land Use Planning and Energy Integration

In the context of the energy transition, integrating land use considerations into energy planning can yield significant benefits (Mosso et al., 2024). Renewable projects often need large land areas, community approval, and thorough environmental assessments. Vanclay (2016) notes that, regardless of purpose, large-scale developments, whether initiated by governments or private entities, usually require extensive land, sometimes very large areas. Poor integration of spatial planning into energy strategies has led to conflicts, delays, and uneven distribution of benefits. Todes and Turock (2017) also argue that strategic installations and national research institutes often face inequalities, highlighting the need for new planning principles to promote more integrated approaches. In South Africa, aligning land-use governance with energy planning is crucial to ensure that renewable energy deployment supports not only decarbonization but also social equity and inclusive growth. The country's energy sector is in a critical phase of transformation, addressing challenges related to access, environmental sustainability, and modernization. This study critically explores South Africa's energy landscape, focusing on policy implications, renewable energy adoption, and the impact of Fourth Industrial Revolution (4IR) technologies reshaping the sector.

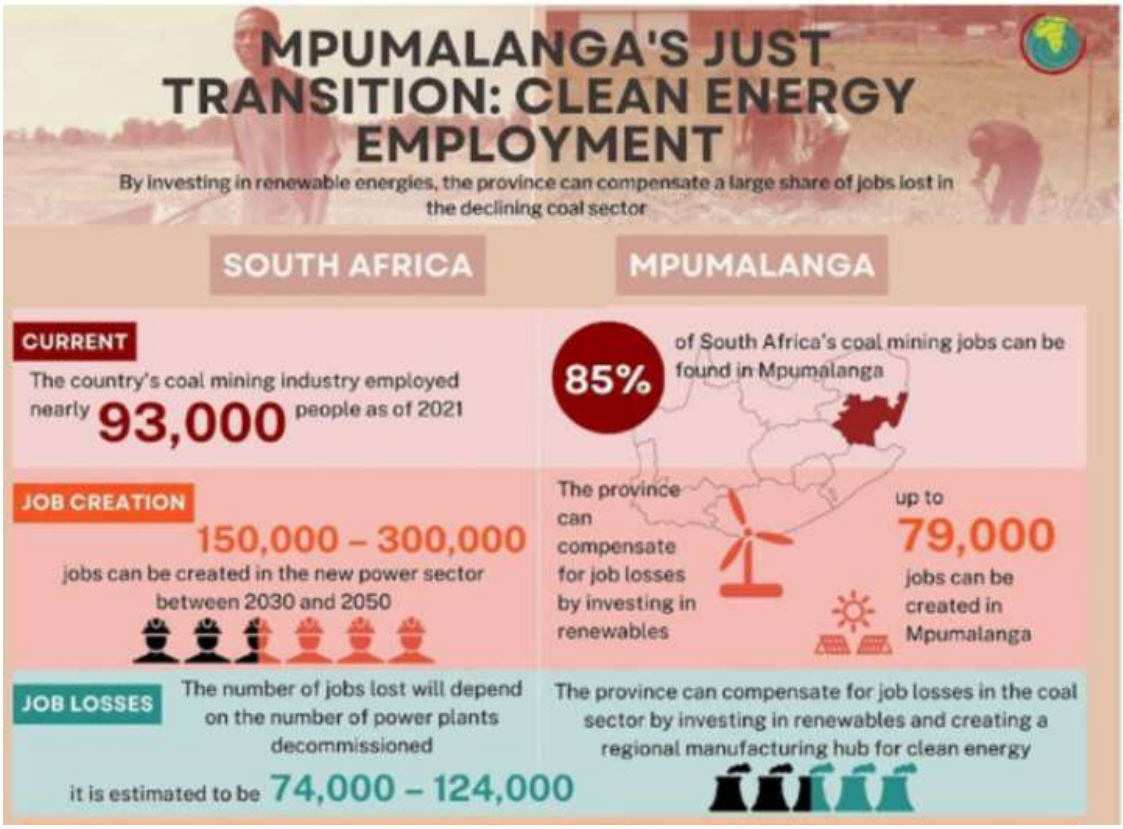

Figure 6: Energy Transition Strategy for Mpumalanga Province in South Africa (Molelekwa, 2023)

4.5 Challenges to a Just Energy Transition

Achieving a just energy transition in South Africa is estimated to require approximately US$99 billion in investment, along with capacity-building initiatives such as workforce upskilling and the implementation of the 2019 carbon tax (Abe & Azubike, 2025). However, progress faces many obstacles, such as low public engagement, limited community backing, insufficient infrastructure, and issues with accountability challenges.

4.5.1 Public Engagement and Social Inclusion

In Africa, vulnerable groups, including women, youth, and indigenous communities, are often marginalized or excluded from energy transition processes. Issues such as uncompensated land seizures and the absence of gender-aware policies exacerbate social inequities and pose significant justice concerns (Abe & Azubike, 2025). Addressing these concerns requires proactive stakeholder engagement, community consultation, and participatory planning to ensure equitable outcomes.

4.5.2 Policy and Stakeholder Coordination

Global frameworks, including the Paris Agreement and the Glasgow Climate Pact, reinforced by the 2023 United Nations Climate Change Conference (COP28), continue to guide efforts to reduce carbon emissions below 2°C and achieve net-zero targets. National policies must balance commercial objectives with government oversight, often creating tensions between private investment goals and public accountability (Abe & Azubike, 2025).

4.5.3 Energy Production and Environmental Challenges

Cities worldwide are responsible for nearly 80% of greenhouse gas emissions, making urban energy systems key targets for climate efforts (Supapo et al., 2021). In the Global South, especially within the SADC region, reliance on coal, economic disparities, and institutional challenges hinder the shift to clean energy. South Africa continues to depend heavily on coal for electricity, significantly contributing to national GHG emissions and environmental harm. Although renewable energy development is increasing, it still falls short of achieving climate and social equity objectives.

4.5.4 Infrastructure and Governance Constraints

Besides technological and financial issues, the energy shift faces hurdles like aging infrastructure, limited grid capacity, and underinvestment in renewable energy. Poor governance and accountability further obstruct effective action, highlighting the necessity for integrated policies, planning, and reform of institutions to ensure sustainability and social inclusion. Tackling these challenges enables South Africa to pursue a fair energy transition that cuts carbon emissions while fostering equity, public involvement, and socio-economic growth in both urban and rural areas.

4.6 Implications and future research

International climate frameworks are increasingly emphasizing the importance of a just transition, especially for workers and communities reliant on high-emission industries. Before COP22 in Marrakech, the UNFCCC published a technical paper on workforce transitions, integrating this concept into the Paris Agreement's preamble and highlighting it in climate talks from COP21 to COP27. In 2021, UN Secretary-General António Guterres emphasized the need to phase out coal power while providing locally tailored support to coal-dependent communities, such as reskilling, economic diversification, and social protection (Mirzania et al., 2023).

Despite multiple government initiatives to transition from fossil fuel–based electricity generation, the effectiveness of these interventions remains uncertain. Merzic (2022) highlights that many energy transition scenarios lack explicit validation or are only applicable under very specific circumstances. South Africa's approach has often focused on privatizing electricity generation, yet there is no clear, overarching framework that integrates renewable energy deployment, social equity, and spatial planning considerations. Questions remain regarding how to transition effectively, how to measure success, and how to align private investment with public goals for a socially just and sustainable energy system. Addressing these gaps is crucial for guiding SOEs, policymakers, and stakeholders toward evidence-based, inclusive strategies that advance the country's just energy transition agenda.

4.7 Conclusion

In conclusion, while state-owned enterprises are central to South Africa's just energy transition, governance gaps, fragmented coordination, and limited community engagement constrain their effectiveness. Applied research and practical frameworks are needed to evaluate SOE interventions and identify strategies that accelerate equitable, sustainable energy transitions.

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