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The regional implications of just transition in the world's most coal-dependent economy: The case of Mpumalanga, South Africa

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Introduction: South Africa has had an extraordinarily heavy reliance on coal to fuel its economy, and it is one of the highest carbon dioxide emitters per capita globally. Current moves aligned with COP26 and recently announced Western support for a Just Transition Partnership to support decarbonisation in South Africa and replace coal fired power stations with renewables are to be welcomed. That said, the majority of South Africa's coal mines, thermal power stations and the currently important coal export industry are located in Mpumalanga's Coal-Belt, an area which has and will continue to experience significant social and economic trauma as mines close and workers needs to be reskilled. There are currently over 100,000 workers in the coal and related industries in this region.

Methods: This paper draws on international and South African evidence of the effects and responses to mine closure, regional resilience theory and evolutionary economic geography theory to analyse the implications and prospects for economic renewal as the coal industry winds down. Evidence is sourced from secondary material including government and industry policy statements and media articles, while primary material was sourced from key informant interviews.

Results: Transitioning this region of South Africa from its virtual mono-economy based on coal presents challenges which this paper highlights. While support from international sources to help make this transition into renewables will be of considerable benefit, significant challenges need to be addressed to ensure that difficulties are overcome, and the risks of the resource curse experienced in many developing countries are minimized.

Discussion: Processes may need to be put in place to ensure that the ambitious goal of transitioning from coal to renewables can be achieved, finances and management well-targeted, and a sense of security given to outside investors to help fund the transition, but also broader economic diversification. In parallel to ensure the "transition is just" mechanisms also need to be put in place, by the state and the investors, to ensure that those citizens unable to transition are empowered and engaged in their community to stem the risk of the inevitable frustration and social disturbance that exclusion from the economy and living with declining services creates. Whom should be putting these processes into place also needs consideration given that existing organizations are already struggling. Though not an easy task, it is hoped that this paper sheds some light on the various issues and encourages consideration of the ways to address them.

KEYWORDS

Just Transition, coal, South Africa, renewable energy, regional resilience, Mpumalanga

1. Introduction

South Africa has the dubious distinction of being the most coal-dependent country in the G20—the international group representing 20 major economies—because it relies on coal for the generation of 89% of its electricity, placing it well ahead of India (74%) and China (68%) and significantly ahead of the 41% average dependence for the whole of the G20 (Climate Transparency, 2019). While in terms of quantity South Africa burns significantly less coal than many other countries, it is this sheer dependence on coal which has deep and significant ramifications for the country, not least because it makes it proportionally more difficult to achieve a ‘Just Transition’ (JT) and to meet the terms of COP21 (COP 21: 21st Conference of the Parties, 2015, UN Climate Change Conference) commitments which South Africa has agreed to Nkwanyane (2019), Burton (2022). The ability of South Africa to achieve a transition to renewable energy production is made more complex by a range of factors. These include strong political and union opposition because of the perceived risks to jobs and the economy of the Mpumalanga province, where most of the coal mines and coal-fired power-stations are located. In addition, there is a deep-rooted dependence on coal, not only for electricity generation, but also for the production of synthetic fuels and the heavy energy needs of the historic core of the country’s economy, known as the “Mineral Energy Complex,” which is anchored on mining, metal and mineral refining and processing, petro-chemicals and general manufacturing (Fine and Rustomjee, 1996; Scholvin, 2014). Other concerns include limited hydro capacity, which is further constrained by increasing drought risk associated with climate change and the current inability of the energy system to meet existing electricity needs. Economic and management challenges which have plagued Eskom (the Electrical Supply omission, the parastatal entity set up to manage and produce the majority of the country’s electricity) through poor planning and mismanagement, slow development of alternate power sources and the weak national economic performance.

Partially in recognition of these challenges which impact South Africa’s ability to meet its COP21 commitments, the fact that South Africa is the world’s 13 largest producer of greenhouse gases and the recognition by leading nations that to slow down global warming, richer countries will have to help weaker ones make the transition away from fossil fuel dependence, the EU, UK and USA jointly announced a Just Energy Transition Partnership in 2021 which will provide US\$8.5bn to help South Africa make such a transition (Burton, 2022). This initial partnership is now being considered for other nations, such as Indonesia and Malaysia and what happens in South Africa will have a bearing on how other countries engage with the leading powers in this regard (Lo, 2022).

While the need to achieve a JT is a national issue in South Africa, the reality, as implied above, is that one province of the country, Mpumalanga, will be the most impacted by any moves to reduce coal dependency. There are an estimated 85,000 coal mining and power generating jobs in that province and these industries provide some 19% of the provincial GVA (Gross Value Added) and nearly 50% of the GVA of Emalahleni, the most coal-dependent municipality (Strambo et al., 2019; COBENEFITS, 2022; Marais et al., 2022). As such, the parallel story to meeting COP21 targets through reducing national coal dependence and developing renewable energy capacity will be the question of how to help Mpumalanga, which will bear the brunt of such changes. In this regard, recent writings regarding regional resilience, which refers to the capacity of a region to respond

and adapt to structural economic change, are useful to refer to, with their reference to the risks of path dependency relative to the prospects of new path creation (Martin et al., 2016; Hassink et al., 2019). South Africa’s current thinking around the development of alternative energy emphasizes the need to locate new facilities and component suppliers for such plants in Mpumalanga (Marais et al., 2022). Whether this will be fully achieved and whether all jobs that might be lost can actually be replaced through new activity is debatable and it is this issue which is the primary focus of this paper. In the following sections, global energy challenges and the concepts of JT and regional resilience are explored before looking at the challenges of mining dependence and closure, the nature of South Africa’s energy dependence and the situation in Mpumalanga. Thereafter follows an overview of how South Africa is engaging with COP21 and renewable energy considerations, the recent Just Energy Transitions Partnership with the US, UK and EU and current thinking about how to achieve such a transition in the country and in Mpumalanga in particular. Next follows a discussion based on field research and semi-structured interviews *via* email with 50 people in Mpumalanga regarding the province’s capacity and ability to achieve a JT and the costs. The paper builds on previous work in the area and on an array of data for the area. In 2018 and 2021, the authors undertook a household survey and 21 key informant interviews in the region. We use these interviews sparingly in this paper through a thematic analysis process and in conjunction with document reviews and available data. Interviews had a clear focus on the situation in the Emalahleni municipal area in particular, the area which would be the most severely impacted by potential job loss. The paper builds on previous work in the area and on an array of data for the area. In 2018 and 2021, the authors undertook a household survey and a range of key informant interviews in the region. We use these interviews sparingly in this paper through a thematic analysis process and in conjunction with document reviews and available data.

2. Global energy challenges and just transition

Central to the global response to climate change and global energy challenges is the need to try and achieve the near total phasing out of fossil fuel dependency by 2050 to keep the global temperature increase below 1.5 degrees Celsius, as agreed at COP21, the Paris Agreement (Climate Transparency, 2019). Despite this, coal is still the world’s single largest source of power, generating 34% of global electricity in 2020. To achieve the COP21 goal, coal use will need to fall 14%p.a. every year to 2050 (Broadbent, 2021). Achieving such goals will be particularly challenging for those countries in the Global South with very high levels of dependence on coal, financial constraints, constrained implementation capacity and the often limited pursuit of alternate options to date. Decarbonising economies and switching to renewables is critical but will prove to be a major challenge for the following large, coal dependent economies in the Global South—India, South Korea, South Africa, Indonesia and Vietnam (Climate Transparency, 2019). In this regard, South Africa will, arguably face some of the greatest challenge because of its sheer level of dependence on coal as a percent of all energy sources. As a source of primary energy in the world’s largest economies, the G20, coal provides an average of 32% of all energy, but in the case of South Africa it rises to 68%, the G20’s highest rate. In the case of dependency on coal for electricity generation, as noted above, the

figures are 41 and 89%, respectively, also the highest rate in the G20 in South Africa's case (Climate Transparency, 2019).

Reducing dependence on coal, while essential, is not simply a case of replacing a fossil fuel source with a renewable energy one. Over and above the financial implications are the challenges faced by coal mining areas and power stations which face the grim prospect of job loss, economic devastation of mining towns and regions and the need to respond to employment changes through retraining, welfare support and trying to identify new regional economic drivers. In this regard the concept of "Just Transition" has been advanced internationally to capture both the need to transition a society and region not only in terms of energy sources but also to ensure that change engages with and supports affected workers and places. In this regard it has been argued that, too date, sustainability transitions don't adequately consider the broader impacts of such discontinuities on local coal communities and their future employment prospects, which is of growing concern to trade unions internationally (Johnstone and Hielscher, 2017). JT is also associated with issues such as "just energy transitions" (Della Bosca and Gillespie, 2018), "just sustainability" (Harrhill and Douglas, 2019), and "environmental justice" (Evans and Phelan, 2016), and it has implications for issues of governance, public policy and perceptions, and how benefits and costs of changes are distributed (Wang and Lo, 2021).

The concept of JT originates from with the union movement having a focus on Green Job creation and an industrial transition, which needs to involve the fair treatment of workers and communities when an industry closes, their re-employment, and the shift to sustainable production. Closely associated are also issues of climate, energy and environmental justice (Marais et al., 2022). Taking the concept further, Gerrard and Westoby (2021, p. 22) argue that JT to a low carbon economy "refers to the social justice issues that need to be considered in developing climate change policy and protecting the environment." As such there is widespread global recognition that in order to achieve COP21, JT is an important co-component of the overall changes which are required (Marais et al., 2022).

Advancing the debate in the social realm, the Climate Just Alliance takes a social justice approach with a clear focus on structural inequalities. They argue that JT needs to build economic and political power to shift from an extractive to a regenerative economy (Henry et al., 2020). Key aspects of a JT according to the World Resources Institute are:

- Income support
- Local economic development
- Training and retraining for decent work
- Knowledge sharing from other areas
- Support for labor standards and collective bargaining
- Sectoral approaches customized to regions (Henry et al., 2020).

Of particular relevance in this study of South Africa is the need to integrate JT and Transitions Management i.e., to more sustainable and socially just energy supply, within the context of the affected "landscape" and local society to ensure local relevance and buy-in, as identified as being critical in Australia (Goddard and Farrelly, 2018).

When countries and regions embark on JT, one of the key risks is that "energy policy and commercial decisions may well be driven by macro-economic imperatives rather than (by) the socio-economic wellbeing of former coal workers and communities"

and hence, decarbonisation could just be the next round of capitalist growth (Harrhill and Douglas, 2019, p. 10). The same authors argue that success will need to be based on comprehensive planning, welfare support, a coordinated approach from key role players and institutions, bottom-up approaches to industrial change, retraining and placement, drawing on hi-tech and R&D support, and area revitalisation.

3. Regional resilience

Fundamental restructuring of the economy of a mining region, such as South Africa's Mpumalanga province which JT and a commitment to COP21 implies, and the associated uncertainties about whether the region has the capacity to fully or only partially transition to a new energy and employment scenario has resonance with the experience of multiple industrial and mining regions globally. Such areas have generally struggled in recent decades to cope with the loss of old economic mainstays, either because of market and demand shifts or resource depletion, often leading to regional decline and effective town abandonment. While cases of successful adaptation to new economies are noted (referred to as "new path creation"), many other regions lag because of their inability to develop new economic pathways, instead being "locked-in" by path dependency (Binns and Nel, 2003; Hassink et al., 2019; MacKinnon and Cumbers, 2019). The latter refers to scenarios in which, because of entrenched institutional systems, narrow worker skills, poor environmental conditions, physical isolation, and lack of interest in the area by alternative investors, decline is experienced as an old industry is wound down and not replaced.

In an effort to understand how regions may adapt, authors such as Dawley et al. (2010), Pike et al. (2010), Simmie and Martin (2010), and Martin and Sunley (2015) and have studied regions and the degree to they can embrace and draw on what they refer to as "regional resilience." Having high levels of resilience and adaptability generally enable regions, their populations and institutions to gradually transition or "re-orientate" old economic systems, fuel sources, technology and outputs to new ones marked by new "path creation" (Martin, 2012; Bailey and Turok, 2016). Elements of strong local leadership, endogenous knowledge, innovation, willingness to change, experience from previous crises, having access to funds, transferrable skills and willingness to retrain, coupled with the availability of resources and market opportunities for a "new" economy are key (Williams and Vorley, 2017; Bristow and Healy, 2018; Henning, 2019). Failure to transition will leave places 'locked-in' to previous forms of economic dependence, the market opportunities for which are diminishing, which can only lead to job loss, weakening of institutions and physical dereliction of the built environment. Where a transition is successful it tends to be associated with positive outcomes which are synonymous with the notions of evolutionary economics and "creative destruction" (Boschma and Martin, 2007). These ideas, and the parallel theory of Evolutionary Economic Geography (EEG), particularly in the light of their regional foci are of particular relevance in the Mpumalanga context where a large part of the province and its population has to transition, not just an individual town or mine (Boschma and Frenken, 2011). EEG draws attention to the degree to which historical processes produce patterns of economic activity across space, which in turn determines the degree to which place dependent processes can either lock in path dependence and narrow opportunities to transition to new economic

activities or provide opportunities for adaptation to new economic opportunities (Boschma and Martin, 2007; Jovanovic, 2008; Asadi and Jafari Samimi, 2022). Historically embedded physical, economic and social processes in a region, such as the study area, which is the focus of this paper, may variously hinder or facilitate the ability to transition to a new economy. EEG is concerned with “the processes of path creation and path dependence (which) interact to shape geographies of economic development and transformation and why and how such processes are themselves place dependent” (Boschma and Martin, 2007, p. 540). These ideas are of relevance in resource dependent areas with respect to understanding the degree to which resilience and adaptability or lock-in can variously hinder or assist transition to new economic trajectories, as has been debated in coal dependent regions in Australia, where the need has been identified to “adapt” to a new “post-carbon” society (Evans, 2008).

It has been argued that in order to help communities transition to post-mining scenarios when closure is mooted, efforts to strengthen local community resilience need to be progressively engaged in through reskilling workers, making facilities and resources available and engaging with communities in an effort to ensure effective and sustainable economic and social adjustment (Syahrir et al., 2021). Linked to resilience thinking, the notion of “regional adaptive capacity” relates to the identification of the characteristics which may better help a mining region to transition to a post-mining scenario. Sharing parallels with EEG and path creation / dependence this approach argues that local resilience capacity and structural realities influence the ability of a mining region to adapt while also providing policy makers with a sense of how challenging transitioning a region might be and what support is needed (Everingham et al., 2022).

4. The risks of mining dependence and of mine closure

While large-scale mining fuelled the economic expansion of many countries in the world over the last 200 years, dependence on it has come with significant risks and costs, which confront areas such as Mpumalanga today. As has been argued “mining is often viewed as panacea for poverty, and a vehicle for economic prosperity ... (but, it) is inherently destructive, resulting in long-lasting environmental damage, social ills and injustices” (Campbell et al., 2017, p. 223) and poses the challenge of how to transition to an inevitable “post-mining” scenario. Over and above the risks of resource depletion and now the requirements of decarbonisation, mining regions also suffer from extreme dependence on a single product, which can skew the structure of local economies, labor, transport and institutional systems through underinvestment in other sectors and limited skills diversification. In addition, a single resource focus can lead to corruption, vulnerability to market fluctuations and associated breakdowns in social systems and cultural conflicts. Various referred to as the effects of the “resource curse,” “Dutch disease” and the “social disruption thesis,” these mono-economy regions are particularly vulnerable if they fail to anticipate and plan for change and the need to adapt (Gylfason, 2001; Ross, 2001; Obeng-Odoom, 2014; Miller, 2015; Smith, 2015; Marais et al., 2017). Mine closure can lead to social disruptions, disinvestment and under-investment, job loss, abandoned and looted assets, physical dilapidation of towns, social and community stress, strains on the

housing market, and reduced local government revenue (Marais, 2013b).

Globally, the World Bank has warned that a wave of mine closures is inevitable which will have traumatic effects on local communities “especially in remote areas if local government is weak and labor productivity and non-mining income are low and labor mobility minimal” (Strongman in Marais, 2013b, p. 504). The literature indicates that few countries and mining centers plan for closure and the need to diversify local economies when inevitable closure occurs. As Marais (2013a, p. 365) argues, “the international experience suggests that both mining communities and local communities are ill prepared to deal effectively with mine downscaling and mine closure, invariably failing to generate post-mining economies.” As a result, planning for closure should, ideally, be embedded in the establishment plans of a mine and while plans for closure tend to focus on environmental concerns, it is equally important to also develop and embed plans for diversification and socio-economic rehabilitation (Marais et al., 2017, 2022). Unfortunately, hindsight is a luxury. Where successful transitions to post-mining have been noted, reworking of the local economy and landscapes have seen a focus on new green areas, farming, new buildings, tourism and renewable energy. In addition, it has been noted that successful energy transitions are more likely to occur in those towns which already have high-tech companies and/or research institutions present, with access to external subsidies (Marot and Harfst, 2021).

South Africa is not immune to the experience of mine closure and a large literature exists on its impact (Nel and Binns, 2002; Marais, 2013b; Marais and Cloete, 2013). To date the worst affected region has been the Free State Goldfields, which saw mine employment fall from 180,000 to 35,000 between 1988 and 2010. This led to population loss in the region, unemployment rose to 53%, businesses closures resulted, building vacancy rose, the housing market has been distorted, the informal housing market grew, there have been a loss of municipal services, on-going environmental impacts and the limited success of recovery efforts (Marais, 2013b). Failure to anticipate and plan for closure has, unfortunately been a hallmark of recent years in the country (Binns and Nel, 2003). Looking forward to inevitable coal mine closure in Mpumalanga, the situation of failing to plan, will be aggravated by the fact that coal mining communities often have negative perceptions of renewable energy because of perceived threats to their traditional local economy and identity (Marais et al., 2021).

5. South Africa’s historic path dependence on coal nationally and in Mpumalanga

As noted above, by international standards, South Africa has an extraordinarily heavy dependence on coal to fuel its economy (Burton, 2022; The Economist, 2022). The historical roots of this dependence lie in the emergence of what Fine and Rustomjee (1996) have referred to as the “Mineral-Energy-Complex” (MEC). Over the last 100 years, the Complex has fostered deep links between mining (coal, gold, platinum and several other minerals), power production, the refining of iron, steel and various non-ferrous metals, petro-chemicals and fertilizers and with associated institutions and the financial sector (Scholvin, 2014). If one just

considers mining nationally, this generates 7% of national GDP and employs 400,000 people directly and 1.4 m indirectly (Marais et al., 2022). In terms of other sectors e.g., non-ferrous metal refining, this grew significantly after the post-1994 political transition, significantly increasing demands for power.

This has created what Fine and Rustomjee (1996) refer to a “system of accumulation” which is the backbone of the economy and which, historically, boomed on the back of cheap labor and power. Such accumulation is now threatened by rising costs, loss of state subsidies, loss of market and disruptions to regular power supply, over and above the need to decarbonise the economy (Scholvin, 2014; Baker, 2017; Campbell et al., 2017). Largely centered on Johannesburg and surrounding towns and cities, these major users of energy consume 44% of all power generated in the country and generate 45% of all carbon emissions, with much of the energy and coal required being drawn from Mpumalanga, parts of which are effectively mono-economies (Baker, 2017). This has created a situation in South Africa, but particularly in the Mpumalanga province of path dependence, which “occurs at critical junctures where natural conditions and social factors jointly induce a course for the future which is extremely difficult to alter at a later point” (Scholvin, 2014, p. 185).

The extreme dependence on coal is exemplified by the fact that in 2020 only 10.5% of the country’s electricity came from renewables (Winkler, 2022). While the latter figure has gradually increased over the last 10 years, progress has been slow, hampered by financial costs, and the apparent reluctance of Eskom and the Energy Ministry to sanction private sector involvement in energy supply (The Economist, 22 January 2022). Coal currently generates some 89% of the country’s electricity and is also the basis for the country’s synthetic fuels industry which leads to a scenario in which ~20% of the country’s liquid fuel is created by a process which converts coal or gas into petrol, diesel and a range of chemicals at plants in Mpumalanga and to the south of Johannesburg (Strambo et al., 2019). As a direct result, South Africa is the 13th biggest producer of greenhouse gases globally (Sguazzin, 2022).

The MEC and the presence of coal deposits has helped to create extreme resource and path dependency on Mpumalanga, which accounts for 80% of all South Africa’s coal production (COBENEFITS, 2022) and 76% of all electricity, generated primarily from 12 major coal fired power stations, out of the 18 in the country (Mpumalanga Green Energy Cluster, 2021) (see Table 1 and Figure 1). The level of dependence is more extreme in the province’s Emalahleni municipality which produces 50% of SA’s energy and hosts 60–70% of the country’s 80,000 coal miners (Marais et al., 2022). Most of the power stations were constructed between the 1960–1980’s and have high levels of water use, while air pollution has turned the region into a pollution hot spot (Esterhuysen and Buschke, 2022).

The other six of the nation’s 18 coal power stations are all in provinces neighboring Mpumalanga and the core of the MEC in and around Johannesburg. Included in the nation’s 18 coal power stations are two brand new ones commissioned in 2021 and 2022 respectively. The first was the Medupi power plant, which cost ~\$10 bn and is the 4th largest coal fired plant in the world and largest dry-cooled power facility. Its generation of 4.7 GW is approximate to some 7% of national demand (Yelland, 2021). The second, Kusile in Mpumalanga was commissioned in 2022. Despite plans to progressively cease operations at other facilities as they age and in line with COP21 agreement, these two brand new facilities could, potentially operate till 2073 (BusinessTech, 2022c).

Turning to the Mpumalanga province as the key coal mining and power generating node in the MEC, the region’s long historical dependence on coal is evident. Coal mining started in the region in the 1800’s (Davenport, 2013) and there are now 111 coal mines in Mpumalanga out of the 126 mines in total in the region (S&P Global, 2022) (see Table 2, Figures 2, 3). Some 50% of the coal mines are currently active with a third being open cast while the balance are either underground operations or a combination of both. As a sector coal mining employment has in fact grown this century. According to TIPS (Trade and Industrial Policy Strategies) (2021b) there were 50,000 coal miners in 2002 and 91,000 in 2020, the growth being associated with increased industrial production and metal refining and growing electricity demands in the country. In terms of the broader coal value chain there are an estimated 16,000 workers involved in the transportation of coal –either road or rail, 10,000 in the electricity sector, 18,000 in petro-chemicals, 7,000 in steel and 7,000 in cement production (TIPS (Trade and Industrial Policy Strategies), 2021b). In addition to domestic use, some 30% of production, equivalent to \$4.6 bn worth of coal was exported in 2017 (Strambo et al., 2019, p. 1). In 2022 coal exports to Europe increased because of the energy demands generated by the Ukraine war. Export potential is however limited by infrastructure and capacity limitations on the dedicated coal export line from Mpumalanga and at the port of Richards Bay (Wessels and Rani, 2016; Parker, 2021). In addition to the risk of job loss, given levels of dependency in the region, the impact could be directly or indirectly felt by over 400,000 people.

South Africa needs to transition from an over-reliance on coal due to global warming, resource exhaustion, price rises, a diminishing international market and the failings of the national power utility to meet growing demand—all of which make mine closure inevitable (Marais et al., 2022). Such a transition will have significant implications on the nature and structure of mining, power generation and the operation of the MEC. Particularly hard-hit will be the coal producing and power station area of Mpumalanga, where there is an urgent need to plan for post-mining, JT and a possible switch to a regional renewable energy strategy (Campbell et al., 2017). An additional cost and planning concern is the issue of scale, given the huge energy outputs of each coal-fired plant a significant number of solar or wind etc. farms would be required to even replace even one.

6. Renewable energy in SA and its opponents

Despite the recent commissioning of two major coal fired power-stations, the country, rather belatedly, has also been pursuing the development of a renewable energy policy. In 2010 the Integrated Resource Plan for electricity which released which seeks to double the capacity of renewable energy generating systems by 2030 (Baker, 2017). In 2011 the Renewable Energy Independent Power Producers programme committed to 92 projects, and by 2015 one third or 2 GW of these were on stream (equivalent to 2% of total electricity generating capacity) (Baker, 2017). The long term goal is to raise renewables to 40% of energy requirements (McEwan, 2017; Marais et al., 2018). To put things in perspective, South Africa would need to install 5 GW of renewable energy capacity very year to 2050 (BusinessTech, 2022a) if the country is to meaningfully transition away from coal by that year and cope with expected growth in

TABLE 1 Eskom power stations in Mpumalanga, 2022.

Name of Power Station	Year commissioned	Year operational	Installed capacity (MW)	Functional?	Nearest town	Municipality	Other information	Listed for closure
Arnot	1968	1974	2,100	Yes	Middelburg	Steve Tshwete	None	Yes
Camden	1967		1,800	Yes	Ermelo	Msukaligwa	Mothballed in the 1990; reopened in 2010	Yes
Duvha	1975	1984	3,600	Yes	Witbank	Emalahleni	None	Yes
Grootvlei	1969		1,200	Yes	Balfour	Dipaleseng	Mothballed in 1990; reopened 2008	Yes
Hendriena	1970	1976	2,000	Yes	Middelburg	Steve Tshwete	None	Yes
Kendal	1982	1993	4,116		Witbank	Emalahleni	A dry-cooled system to reduce water use	Yes
Komati	1961	1966	1,000	Yes	Middelburg	Steve Tshwete	Mothballed in 1990; reopened in 2011	Yes
Kriel	1969	1979	2,850	Yes	Kriel, Ogies	Emalahleni	None	Yes
Kusile	2008	2017 first unit in operation	4,800	Yes	Witbank	Emalahleni	Not fully functional yet; Only 4 of the 6 units are functional	No
Majuba	1983	1996	4,110	Yes	Volksrust/ Amersfoort	Pixley ka Seme	None	Yes
Matla	1974	1983	3,600	Yes	Secunda	Govan Mbeki	None	Yes
Tutuka	1985	1990	3,654	Yes	Standerton	Lekwa	None	Yes

Adapted from Eskom (2022). Data on the few non-Eskom power stations was not available to the authors.

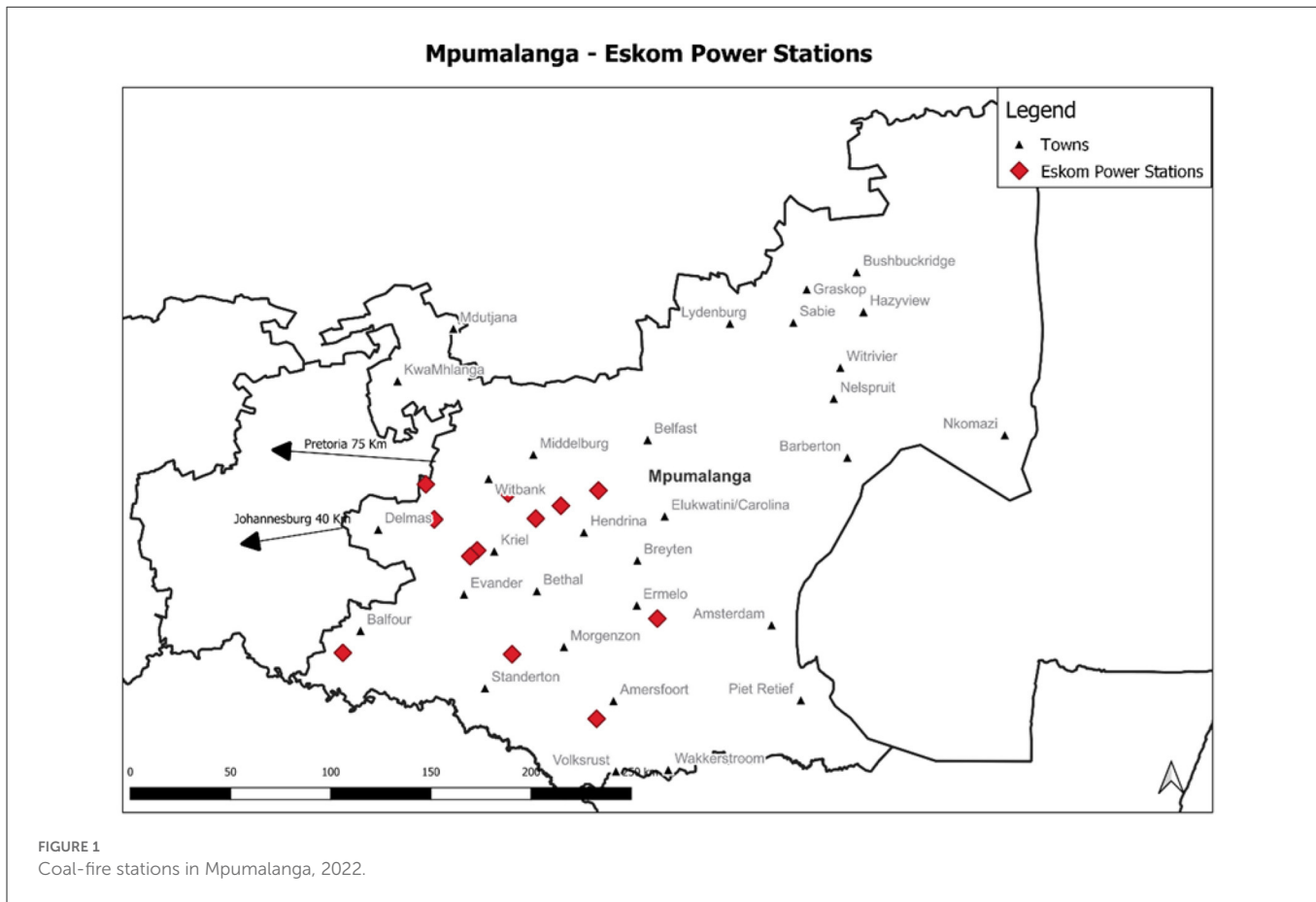


FIGURE 1 Coal-fire stations in Mpumalanga, 2022.

demand (Cock, 2019). A positive step is that the non-coal mining industry i.e., gold mining etc., which use 30% of electricity supply, is aiming to build 73 self-generation facilities to reduce dependence on the national grid, which will largely use renewable energy sources (BusinessTech, 2022d).

In addition to the pursuit of solar, wind and hydro options, development of hydrogen based energy capacity is receiving significant attention. A “Hydrogen Road Map” has been developed which links nine proposed catalytic projects worth \$1.2 bn along what is identified as a “Hydrogen Valley Corridor” with an anchor in the country’s platinum mining and producing region—given that metal’s key role as an electrolyser in the production of hydrogen. This project could create 30,000 jobs and generate a turnover of \$4 bn p.a. (BusinessTech, 2022b).

While these belated moves are to be welcomed, the potential loss of coal mining and power sector jobs with a transition to renewable energy is causing real concern to potentially affected communities and the unions. Threats to the already high unemployment rate—standing at an estimated 37%—have become politically contentious, with the current Energy Minister arguing that shutting down multiple coal plants too rapidly was “economic suicide” (Preyser, 2021). The two largest unions representing 650,000 workers back continued coal mining and a leader of the working populist Economic Freedom Fighters party argued that renewable energy is “a colonial takeover engineered by the West” (The Economist, 2022, p. 51). This dynamic will require the state, current mines, power suppliers, and renewable energy companies to engage with affected communities and contribute to new socio-economic and enterprise development

in those areas. In this regard, lessons must be learnt from other mining towns that previously experienced loss (Marais et al., 2018). An additional concern is not just the social and labor impact on the mining and power generating areas, but also the potential impacts on labor-supplying areas located in the impoverished periphery of the country.

7. Achieving a Just Transition in South Africa

7.1. The South African government’s commitments to achieving a Just Transition

In 2017 the South African government’s National Planning Commission launched a project entitled “Pathways to a Just Transition in South Africa,” which committed the country to the phasing out of its dependence on coal in favor of renewable energy. This built on the country’s signing in 2016 of the COP21 agreement committing it to global carbon reduction targets (Burton, 2022). In 2021 the government’s Department of Minerals, Resource and Energy released a Framework document outlining their response to climate change and JT (DMRE, 2021). The document acknowledges the risks JT will pose to coal miners and power station employees in Mpumalanga, while recognizing the risks to host municipal areas little attention is devoted to how they should respond. A core focus of the document is on proposed re-industrializing the region with a focus on green hydrogen, renewable and associated manufacturing,

TABLE 2 An overview of the coal mining in Mpumalanga.

Indicators	(N)	(%)
Total number of mines	126	100
Total number of coal mines	111	88.1
Type of mining		
Only underground	31	27.9
Only open pit	38	34.2
Combination of underground / open pit	37	33.3
Combination of open pit/dragline	4	3.6
Combination of underground and tailings	1	0.9
Nature of mine activity		
Active	56	50.5
Inactive	26	23.4
Care and maintenance	7	6.3
No information	22	19.8
Starting dates		
Before 1990	10	19.6
1990–1999	3	5.9
2000–2009	14	27.5
2010 +	24	47.1
No data	60	n.a.

Source: S&P Global (2022).

which it is hoped will re-employ former miners. It would seem that insufficient attention is paid to the direct effects of mine closure and alternative forms of economic diversification in this document. In a parallel move, the Renewable Energy Independent Power Producers Program has been established in Mpumalanga to promote renewable energy and local content.

In 2022 the Presidential Climate Commission released a “Just Transitions Framework” to manage JT in the country. The document focuses on the affected workers, job losses in the coal value chain and impacts on the region. Policy responses in this document are anchored on human resource development, economic diversification and social protection. Attention is paid to the provision of green jobs, climate proofing infrastructure and settlements and supporting local governance. Overall the JT framework “supports South Africa’s broader efforts to redesign the economy to the benefit of most citizens to enable *deep*, *just*, and *transformational* shifts, in the context of delivering an effective response to climate change (i.e., improving resilience, making substantial cuts to greenhouse gas emissions, and protecting and promoting the health of communities)” (Presidential Climate Commission, 2022, p. 4). The document identifies phased closure of coal mining and the decommissioning of coal fired power stations in parallel with the provision of renewable energy and new job opportunities in the period from 2021 to 2050 (Presidential Climate Commission, 2022).

While necessary and praiseworthy, pursuing these goals and strategies will inevitably negatively impact on employment and regional economies. In addition, there is concern that the government documents do not adequately account for how difficult transitioning

and diversifying the region’s economy will be. There is also a sense that local realities and the constraints which local municipalities face are not being fully accounted for. Achieving the current COP targets will probably lead to a 75% loss of jobs in the coal industry. As a result, JT arguments, as discussed above, become all the more critical in the South African context meshing with debates about climate change, racial, gender and economic justice and associated concerns about environmental degradation and the costs of rehabilitation (Marais et al., 2021). JT in Africa requires “an intersection of sustainability transitions, socio-political regimes and the development state, a JT would consist of a dual commitment to human wellbeing (concerning income, education and health) and sustainability (concerning decarbonisation, resource efficiency and ecosystem) restoration” (Swilling et al., 2016, p. 650). In this regard, the unions are particularly anxious to ensure that the livelihoods of affected workers and communities are protected (Cock, 2019). The goal identified by NEDLAC (the National Economic Development and Labor Council) is to achieve a shift toward low carbon, climate resilient and ecologically sustainable economies and societies which leads to the creation of goals of decent work for all, social inclusion and the eradication of poverty (TIPS (Trade and Industrial Policy Strategies), 2021b).

The cost of JT, including a shift to green energy in South Africa, will be \$250 bn over 30 years (Sguazzin, 2022). SA’s Integrated Resource Plan commits the country to decarbonise—which hinges on decommissioning coal-fired power stations and the rapid uptake of renewable energy. Over and above the costs of decommissioning mines and power stations and building new facilities, transition costs will include: retirement packages, pension guarantees, migration of workers to other sectors, retraining, compensation and matching skills to new activities (Cruywagen et al., 2019). In this regard it is noted that a climate stabilization project must unequivocally commit to providing generous transition support for workers (Pollin and Callaci in Cruywagen et al., 2019, p. 2). Contextual factors which will impact the ability to achieve a successful JT include path dependency in the producing areas, their narrow skills base, limited opportunities for diversification, weak institutional capacity, current social and employment schemes which lack long-term sustainability and the current market focussed paradigm (Marais et al., 2021).

It is recognized in the country that mine and power station closure also needs, as far as possible, to embrace the pursuit and development of renewable energy production in the same areas. A current goal for Mpumalanga is “repurposing the region’s development to be a hub for generating renewable energy (and) is, therefore, one viable option for regional economic development that could smooth impacts on coal plant workers” (Strambo et al., 2019, p. 4). The region’s pre-existing electricity infrastructure does provide a competitive advantage for the development of new electricity generating facilities. Additional options identified for the region and its workers include the development of agriculture, redeployment and retraining, developing links to other sectors and early retirement options.

7.2. The Just Energy Transition Partnership

Following South Africa’s commitment to COP21, in 2021, the EU, UK and USA committed to a comprehensive package of \$8.5

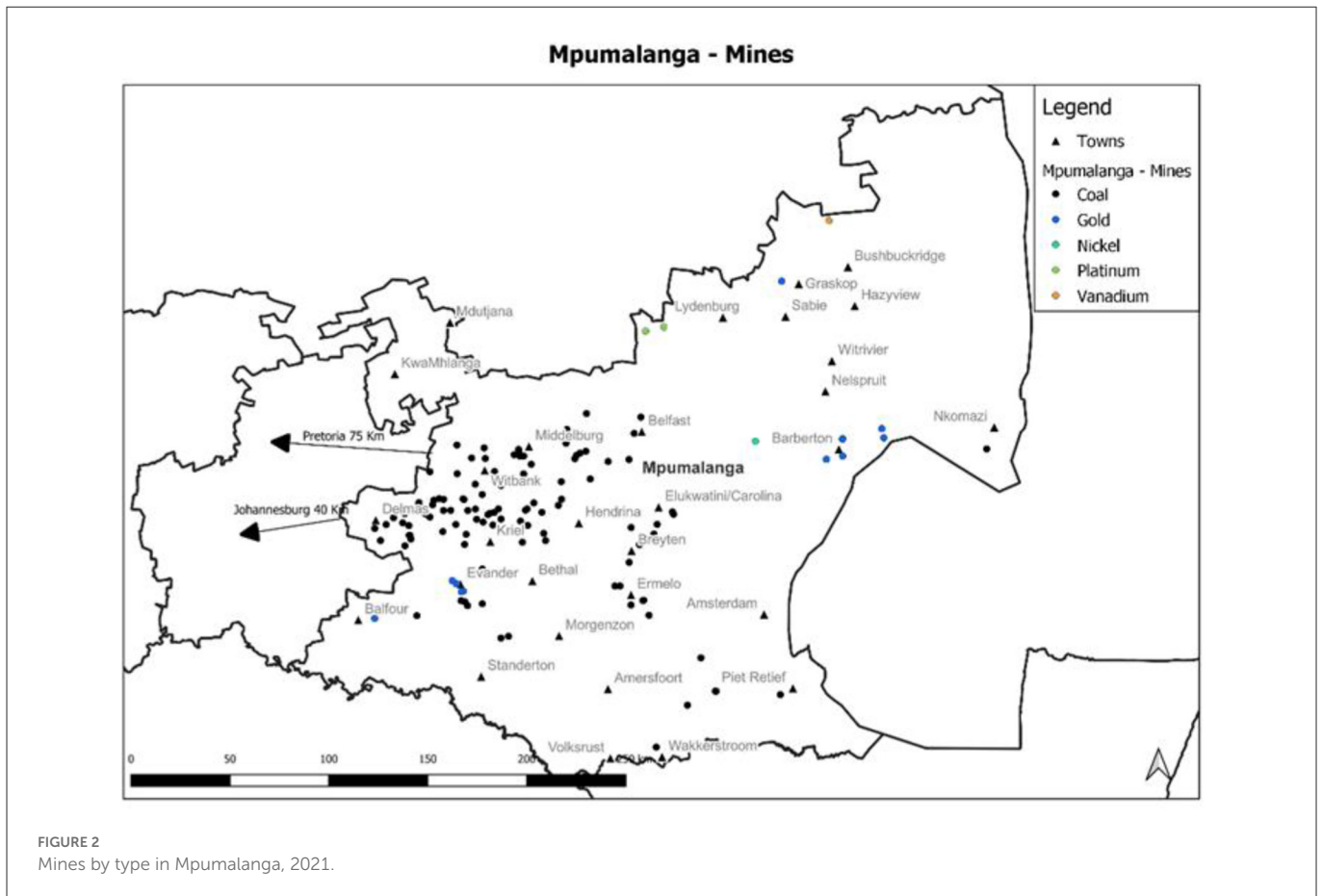


FIGURE 2
Mines by type in Mpumalanga, 2021.

bn of loans, grants and risk sharing to help the country achieve its COP21 targets and achieve a JT for affected areas and communities (European Commission, 2021; Fin24, 2022). In return, South Africa has agreed to decommission 10.7 GW of coal power by 2030 (~20% of the current capacity) and generate 28 GW from renewables and the repurposing of power plants (COBENEFITS, 2022). The programme should eliminate 20 Giga tons of emissions over the next 20 years. According to European Commission President Ursula von der Leyen, “this partnership is a global first and could become a template for supporting JT around the world” (Skidmore, 2021). President Biden stated that the international funding would ensure “equitable, inclusive transitions in South Africa’s coal sector by helping regions and workers in coal industries affected by the phase-out” (Mason and Rumney, 2021). The Partnership could be a model for energy transition deals in countries such as Vietnam and Indonesia (BusinessTech, 2022a). As noted above, other countries are now exploring the possibility of establishing similar partnerships (Lo, 2022).

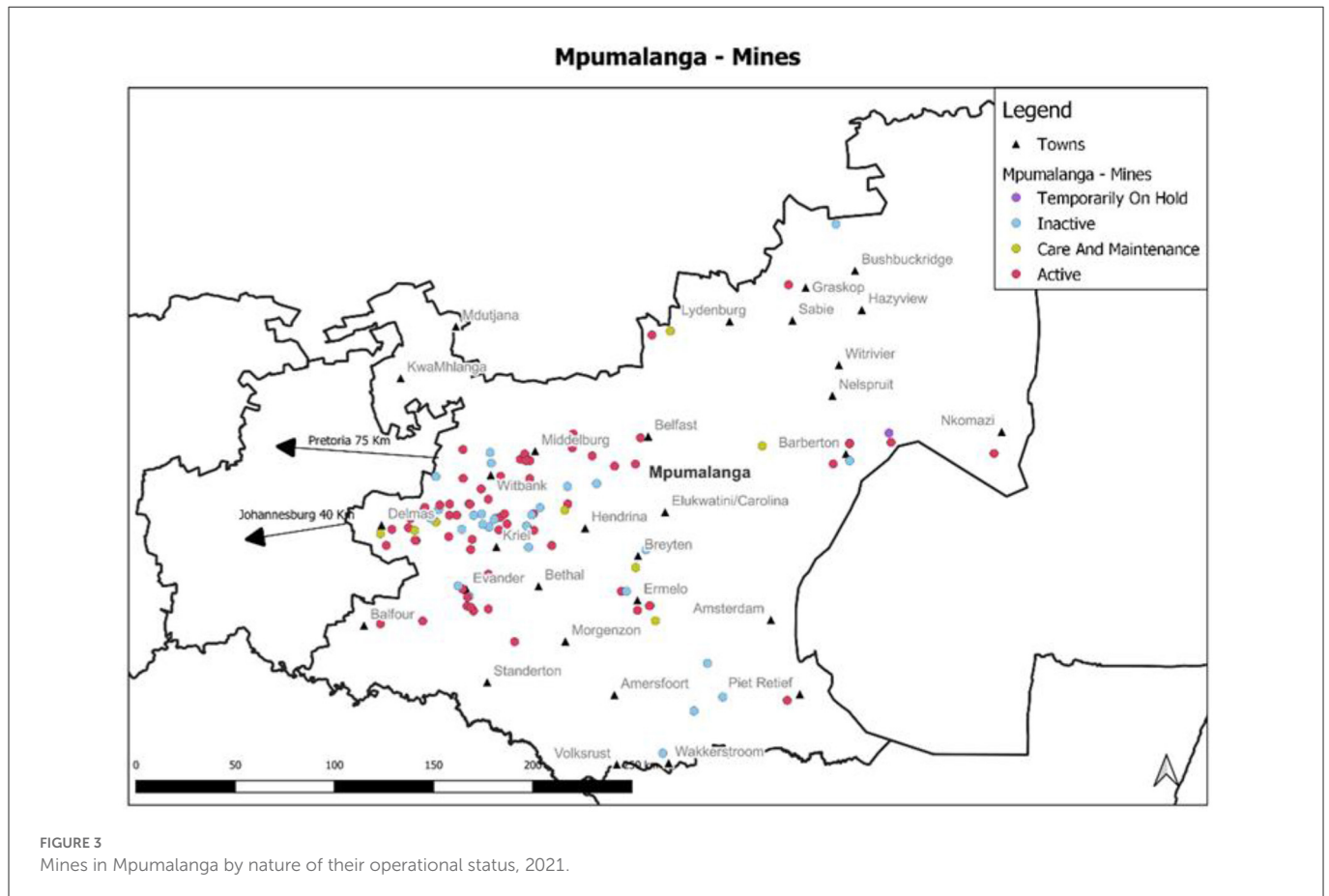
The international funds will be paired with a \$10 bn ESKOM plan and will form the basis of an initiative to close most coal plants by 2050 [likely to cost in total \$250 bn (Sguazzin, 2022)]. These two sources of funds will form part of an estimated \$35 bn needed over the first 15 years to transition to renewables. It is hoped that the shortfall will be met through foreign investment (Preyser, 2021). In the case of Mpumalanga, discussion around the plan’s implementation recognizes that some 85,000 jobs could be lost, but it is envisaged that 72,000 jobs could be created in the region in the renewable and

hydrogen energy sectors and in associated manufacturing activity. The plan also envisages skills training and developing a Special Economic Zone for green industries (COBENEFITS, 2021).

8. Opportunities and challenges facing the achievement of a JT in Mpumalanga

There are real risks to jobs, communities, towns and the Mpumalanga province as South Africa embarks on a JT path with overseas support. Despite the optimism expressed above regarding the potential to embrace renewables, challenges exist regarding whether the region has the capacity, resilience and commitment to achieve the transition and regional adaptation. Drawing on secondary source material and primary research undertaken in Mpumalanga, this section explores local realities and perceptions of both the need and the capacity to undertake the necessary transition.

As noted above, while there is very real commitment to achieve a JT in South Africa, and to honor COP21 commitments and there is significant international commitment to support such as transition, significant challenges exist to attaining these objectives. This section discusses the potential challenges which will impact on the ability to achieve a JT in Mpumalanga between 2021 and 2050, as well as the negative unintended consequences which JT may well-lead to. Achieving a JT will depend, to a very significant degree, on three variables; first the political will and leadership from national, provincial and local government to guide a JT and manage its



effects, secondly whether the costs incurred can be afforded and the risks of managing the associated debt can be addressed, and thirdly the question of the degree to which workers can be reskilled, unemployment risks reduced and new opportunities provided to sustain the wellbeing of the region's population, municipalities and businesses.

8.1. The capacity of government and governance

While the national government has committed to achieving a JT and is developing policy in response, translating policy into concrete action, direct fiscal support and strategic leadership is lacking and needs to be expedited. Potentially more serious is the, to date, limited response from the Mpumalanga provincial government, which should be taking a lead role in the restructuring of the region's economy. This is all the more urgent given the finding of the COBENEFITS (2022) study that while country will, experience job gain as a result of JT, it is likely that Mpumalanga will experience a net job loss. The province's most recent economic plan in the 2011 Mpumalanga Economic Growth and Development Path (Mpumalanga Provincial Government, 2011), did not consider the risks of substantial mine or coal-fire station closures and simply reinforced historical economic dependency, arguing that the "mining industry remains one of the important economic sectors in the

Province for economic growth and job creation" and "commodities are critical for growing the economy" (Mpumalanga Provincial Government, 2011, p. 65). A decade later, the long-term potential of mining has evaporated and there is now clearly a significant policy deficit, particularly as plans for mine and power station closure are now developing. On the positive side, in response to the pressures of closing coal-fired stations, the Mpumalanga Provincial Government established the Mpumalanga Green Cluster Agency. This is a not-for-profit organization, which in collaboration with Green Cape (and with funding from the German aid agency GIZ), was set up to help the province with the JT in May 2022 (Hako, 2022). The organization states that: it "works at the interface between business, government, and academia to identify and remove barriers to an economically viable green economy catalyzing their uptake to enable the region and its citizens to prosper" (Mpumalanga Provincial Government, 2011). The chairperson of the Agency, Dr. Mali said that the province has the potential to be a "world-leading region in creating decent, green jobs by creating the enabling environment for new investments in low carbon growth" and it will "remove barriers to an economically viable green economy catalyzing their uptake to enable the region and its citizens to prosper" (Hako, 2022). The initial emphasis of the cluster has been on providing market intelligence, linking the existing electricity infrastructure to renewables, carbon capture and storage, hydrogen, and clean aviation fuel. Although it is too early to assess the role of the Agency and its implementation potential, it could help the province transition.

Equally important is the need to ensure that local governments have the vision, capacity and resources to respond to the effects of inevitable mine closure, job loss and economic restructuring, especially given the potential loss of local rates and taxes and the risk of in-migration of vulnerable people from closed surrounding mines. The challenges are compounded by the local governments' limited capacity to address inevitable welfare-related challenges (Marais et al., 2022) and the "scant recognition of the (risks of) looming mine closure" in municipal documents and policy (Marais et al., 2022, p. 388). Lack of capacity and severe financial constraints impact local governments' ability to act or envision a different future. Yet acting now is critical, as "managing these risks is essential for gaining social acceptance and reducing resistance toward these transformations, and are making sure that poverty and inequality—are not deepened by an unplanned transition" (Strambo et al., 2019, p. 1). Despite how important these considerations are, JT thinking and policy in the country has not yet recognized the degree to which significant local governance constraints will impact the ability to bring about change (Marais et al., 2022). At this point, the risks and dangers hinted at by the "resource curse" theory appear very real (Campbell et al., 2017). An investigation of the Integrated Development Plans (IDPs), the key local government development strategy documents, of the three most at risk municipalities of significant economic change—Emalahleni, Govan Mbeki and Steve Tshwete—indicates that serious engagement with the potential implications of JT, are, to date, modest at best (Emalahleni Local Municipality, 2022; Govan Mbeki Local Municipality, 2022; Steve Tshwete Local Municipality, 2022).

All three IDPs note the risks of land abandonment, and the risks of the failure of mining companies to rehabilitate land. Also noted are the risk of growing crime. Only the Steve Tshwete IDP specifically states that restoring mine land is important "to unlocking the value of land and planning land uses in the future post-mining" (Steve Tshwete Local Municipality, 2022, p. 109). The Emalahleni IDP emphasizes the importance of considering renewables and the green economy. In Steve Tshwete, there is an acknowledgment of mine and coal-fire station closures and the need to link the Social and Labor Plans of mines and IDPs of the municipality to ensure the overall growth and development of the municipal area and "the reskilling of workers for new economic activities" (Steve Tshwete Local Municipality, 2022, p. 109). Renewables are also seen as the automatic replacement for coal. Plans are not however currently linked to concrete actions.

The current reality of potential mine and coal-fire station closures is best described in the Steve Tshwete IDP, referring to "a high dependence on the coal mining industry with little manufacturing and scope for diversification," the volatility of commodity prices and the likelihood of closure of coal-fire stations and mines will affect the local economy (Steve Tshwete Local Municipality, 2022, p. 108). The Steve Tshwete municipality's IDP also identify mine closure and the effect it will have on municipal income. Reference is made to planning for the 'resultant impact of downscaling and the possible closure of mines and the possible decommissioning of power stations as this impacts on the employment levels and capacity of residents to pay for services' (Steve Tshwete Local Municipality, 2022, p. 109). Our municipal interviewees had concerns about the continued payment of rates and taxes by residents when closure sets in, which would compromise future municipal financial capacity. The Govan Mbeki IDP warns against the likelihood that more people will flock to the main towns when mine closure occurs. Although many mining and

power station villages have been closed over the last two decades (van der Watt and Marais, 2019), some still exist, and people might move to the main towns at closure.

Despite these positive attempts, the IDPs do not leave an impression of urgency (and a realization of the need to acknowledge the potential effects of the transition). There is very little reference to mine and coal-fire power station closures. For example, the Emalahleni and Govan Mbeki IDPs only make one reference to mine closure each and Steve Tshwete's four times. There is little reference in the documents to the fact that these transitions might lead to lower municipal incomes (taxes and services sales), nor of the need to use land use regulations during economic hardship to promote economic development. The limitations of the formal strategic planning instruments have already been noted elsewhere (Marais et al., 2021, 2022).

A key role in JT in the province is the role which the parastatal, Eskom, which owns the majority of the country's power-stations, needs to play in taking a lead role in switching from non-renewable to renewable energy sources. Over and above the need to phase out coal-fired power stations, in terms of JT, Eskom is making its unused land (36,000 ha) available to renewable energy companies (Parker, 2022). These companies will lease the land from Eskom and supply electricity to specific buyers. In addition to the land lease income, Eskom will also charge a distribution fee for using its grid. The CEO of Eskom, Andre De Ruyter, said that this renewable energy drive "could transform the coal province of Mpumalanga into a global 'flagship' of the just energy transition" (Creamer, 2022). The initial project will add 1,800 MW to the grid and be on 4,000 ha of Eskom's land (Parker, 2022). Eskom and the Mpumalanga Provincial Government also signed a memorandum of understanding to build on these advantages and promote renewable energy in the province. Given the urgency of the transition and the key role Eskom needs to play, these initial JT steps by Eskom appear modest at best.

8.2. Financial considerations and the risk of debt and corruption

As noted above, achieving a JT in South Africa will cost an estimated US\$35 billion in the first 15 years of the transition (Preyser, 2021), of which \$8.5 bn will be sourced from the above mentioned Just Energy Transition Partnership, \$10 bn from Eskom and the rest will need to be sourced from international markets (European Commission, 2021; Fin24, 2022). Raising this level of finance by a middle-income country, given the current state of fragility of the global economy will be a challenge in its own right, over and above the ability of the country to repay the debt. The latter situation will be further complicated by the country's recent legacy of extensive corruption associated with recent mega-project developments—in the re-equipping of the defense force, power station development and the purchase of transport equipment. This situation is overlain by direct political interference known locally as "state capture" in purchasing system (Salahuddin et al., 2020; Gray, 2021). This has resonance with the findings of Moyo (2009) who cites concerns that substantial and continuous large sums of grant money going into Africa, in the case of aid grants, has resulted in the financing of elites, nepotism, corruption, large unwieldy and un-productive public sectors, lack of urgency and of citizen scrutiny, which is usually the outcome when

where there is limited obligation to repay. Similar concerns about the corruption risks associated with new clean energy projects in South Africa and elsewhere have been raised by [Sovacool \(2021\)](#). Care will therefore need to be taken that the considerable financing of the transition results in fast and productive implementation, in such a way that gives the confidence to outside private sector finance partners that this project will require, if the mega-project is to receive continued tranches of funding for 30 years. This will be required for both the larger energy transition projects, to protect workers and address nepotism as well as to reduce the risk of rent-seeking in the value chain ([Gray, 2021](#)).

Ease of doing business will be important for those wishing to enter new forms of employment whether they are locals or new investors who may be attracted to investing in the area and utilizing some of the now underutilized assets. Unfortunately, South Africa was ranked by the [World Bank \(2019\)](#) in 2019 as the 84th in terms of ease of operating a business, with the greatest ease at the time being New Zealand at 1st and Somalia one of the most difficult at 190th. To give some perspective, Kenya is easier to operate in at 56th and Zambia is nearby at 85th. While Rwanda is ranked a high 38th in ease of doing business, companies find complaints about nepotism or state capture in Rwanda are not being addressed, showing that the prompt addressing of contract failures is also highly important. While ease of business is often a central state influenced process, a local municipality may be able to assist businesses by advising on finding fluid ways through the process of business obligations. [Moyo \(2009, p. 102\)](#) recognizes the importance of a country having regulatory “teeth” to give investors some security that there is somewhere to go if their contracts should falter, to ensure that peoples employment rights and the environment are protected. Regions can also independently promote their area to investors, both those willing to consider large projects like the solar and wind farms, but also to smaller investors interested in utilizing the region and its assets.

8.3. Social and employment concerns

The drive to replace coal with renewables might not automatically benefit Mpumalanga and its towns. As noted above, the economic modeling shows that South Africa will have a nett gain of jobs as a result of JT, but Mpumalanga will, most likely, lose jobs ([COBENEFITS, 2022](#)). Over the last decade, most new renewable energy projects have been in the Eastern, Northern and Western Cape Provinces, so getting renewable projects to Mpumalanga or wanting Mpumalanga to benefit from renewables’ upstream or downstream activities will require a concerted effort.

On a social level, as noted in the case of earlier mine closure by [Siyongwana and Shabalala \(2019, p. 367\)](#), closure leads to “poverty, deterioration of living standards, increase in outmigration, emergence of crime and diseases, decline in the provision of services, reduction in employment ... limited money circulation, reduction of buying power and in the payment of rates.” This in turn leads to dependence on severance packages, support from relatives, finding jobs elsewhere, farming and reliance on the informal sector. In addition, mine closure runs the risk of bringing about “social disruption” because of the challenges to place attachment and risks associated with home ownership in a declining region ([Marais et al., 2019](#)).

Providing alternative employment for workers losing their jobs in the coal industry will be difficult, but some options are available ([Bichhoff-Niemz, 2019](#); [TIPS \(Trade and Industrial Policy Strategies\), 2021a](#)). The difficulty lies in mine employment which is unrelated to the skill sets required for renewables. This lack of relatedness means that Mpumalanga and its urban areas might struggle to create these jobs and, as a result, reskilling of mineworkers will be crucial in these or in other areas. Though some people will successfully transition to new activities outside of coal, other people will be unable or unready to make such a transition, this may also include vulnerable people who may migrate into an area to utilize redundant housing. This will necessitate two forms of project support. The first for those willing and able to transition to new activities or start their own businesses and achieve financial independence. The second is the establishment of ongoing programs to engage those who are unable or unready to transition to new forms of work, to enable these individuals to have some sense of worth, reducing the risk of social discontent.

Loss of jobs in the coal value chain will have significant impacts on the housing situation and the housing market in the region, not least because of the compromised ability to pay rents, mortgages and service charges and rates. Historically miners were accommodated in mine accommodation, but after the post-1994 political transition, home ownership was encouraged and actively promoted by the mines and the government. Mine closure however now risks seriously devaluing the housing stock owned by miners who face the risk of job loss and inability to sell their homes—or in the case of rental accommodation, to pay their rents. This reality has already severely affected goldmining towns where mines closed from the 1990’s ([Marais and Cloete, 2013](#); [Cloete and Marais, 2021](#)). In parallel with the development of formal housing, mining has also led to the growth of large informal settlements with associated risks of deprivation and poor services as people were drawn in by the hope of employment—often on a contract basis ([Marais et al., 2018](#)). Job loss; which could affect upwards of 80 000 miners and 40 000 power utility workers, will now aggravate conditions in such areas which may well grow, as some people may lose their formal houses while others move in from smaller settlements impacted by closures.

Closing mines and coal-fired power stations will affect Mpumalanga’s economy and urban centers. Survey respondents in interviews cite the possibility of the outmigration of people because of the need to find a job elsewhere, but also because people “return to their places” (Respondent 1, 2021), with 25% of households in Emalahleni having household members living elsewhere 10 years ago ([Marais, 2023](#)). A point often not considered when focusing only on Mpumalanga is that a significant percentage of mineworkers have substantial linkages to people elsewhere in South Africa. [Marais \(2023\)](#) found that 68% of mineworker households in Emalahleni send money to people elsewhere in the country—such as the former Homeland regions. Although the consequences of closure will affect Mpumalanga most directly, the effects will also be in other geographical areas. Job loss and outmigration will lead to declining local tax and rates revenues and service fees and more pressure will be placed on maintaining infrastructure, exacerbating previously noted financial management and infrastructure problems in the region and for the Emalahleni municipality in particular ([Campbell et al., 2017](#); [Marais et al., 2022](#)).

The mines currently play an important role in maintaining social and physical infrastructure, for example [Campbell et al. \(2017\)](#) noted that the mines sold purified water to the municipality, while

van der Watt and Matebesi (2021) identified the role which the mines currently play in infrastructure maintenance, a situation which mine closure will compromise. In addition, one respondent said that the “mines often help with community development finance. In their absence, funding will be limited” (Respondent 1, 2021), while another commented that “when the mines close, the roads are left with potholes” (Respondent 2, 2021). Another respondent said that the closure of the mine would require the municipality to increase its infrastructure budget (Respondent 3, 2021). Soberingly, one respondent stated that, “the mines will speak to their people, and when the coal is finished, they will go” (Respondent 4, 2021).

Finally, respondents also expressed concern that increased unemployment, would contribute to more crime, an increase in unwanted pregnancies and gender-based violence. Sesele and Marais (2022) have already identified the growth of these problems following gold mine closures elsewhere in the country. Although the evidence of a direct relationship between crime and poverty is limited, respondents often referred to it. One said, “we will be affected deeply. I mean, unemployment and crime are already high; without the mines, our situation would be worse. These mines are at the core of our community” (Respondent 5, 2021). Of equal concern is South Africa’s recent accounts of unrest due to frustration over lack of access to basic services, jobs and education, which is at risk of occurring in Mpumalanga through general social frustration and strikes.

8.4. General concerns

Having a strategic approach toward mine closure, addressing environmental damage and land rehabilitation is important, as is the need to redevelop land to enable new activities. Our interviews raised the concerns of leaving land unrehabilitated and the long-term environmental consequences and fear that the “mines will not leave the environment in a healthy state” (Respondent 6, 2021). Developing alternative economies on rehabilitated land depends on appropriate closure and post-closure implementation and funding. Several mines also mine on behalf of Eskom on land for which Eskom holds the mineral rights for. By law and because it is a state-owned company, Eskom does not need to comply with the same land rehabilitation requirements that the large private sector firms are required to. This reality holds long-term environmental and economic risks. Eskom is currently looking at ways to use vacant land, possibly not fully rehabilitated, for renewables and rent their land to private service providers. A broader regional approach is needed toward mine closure and land rehabilitation a system that has some ability to promptly hold agents accountable and with some teeth.

9. Discussion and conclusion

As reflected in the preceding discussion, South Africa’s urgently needs to transition away from its extreme dependence on coal as a source of energy and of income is both desirable and essential. That said, as this paper has argued, the current high levels of dependence on coal, the sheer cost of making the shift to renewables, the compromised capacity of Eskom, and questions about whether the country will be able to access the funds required to make the transition and to steward the funds raised correctly, are likely to be major hindrances in any changes. In addition, the \$18.5 bn which

seems to be what is currently available to achieve the transition is woefully short of the envisaged \$ 250 bn which it is believed will be needed in total (Sguazzin, 2022). Therefore, creating an environment that is fair and transparent for investors is critical. Whether this is investors in the large scale solar and wind farms or investors that utilize the energy or smaller businesses which help to diversify the economy. To avoid the misappropriation of substantial grants, external funding could be in staggered bonds, requiring each stage to be repaid before the next is released. Guarantees offer investors some security, while firm regulations at national or regional levels can ensure that any faltering in contracts, environmental or workers agreements are promptly investigated and addressed. For smaller businesses way-finding through regulations can be advantageous and for very small initiatives micro-funding via Grameen bank type loans could offer women in particular, the chance to engage in new economic activity (Moyo, 2009). However, establishment of systems of accountability would be challenging in South Africa where municipalities and provincial governments are already stretched.

Of equal concern is whether the Mpumalanga coal belt and its provincial administration and local municipalities are preparing for the inevitable collapse of the current mining and energy generating base and if they are adequately preparing to address social and employment challenges, encourage new economic activity and renewable energy generation and build local adaptive capacity and resilience. If planning is lacking, certainly effective implementation will be a concern. In this regard worrying concerns are discernible. The province does not appear to have in place appropriate economic strategies, and efforts to develop green industry are only in an incipient phase. Local municipalities, while acknowledging the risks of closure, seem to lack the vision and capacity to plan for inevitable social disruption and put in place new economic and social systems (Marais et al., 2022). Indeed, much could be achieved by the promotion of the region’s underutilized assets in an attempt to attract new investors, with of course safeguards put in place to protect the environment and population. But, at present, the agency with the energy, skills and finances to undertake such a task does not yet exist. It is apparent that all levels of government need to step up and respond to these very significant challenges as a matter of extreme urgency. Funding, support and leadership are needed to reduce risks and show genuine commitment to change. In this regard acknowledging and responding to COP commitments is also essential.

If the experience of gold mining towns in the country, which underwent closure from the 1990’s is used as a window into what might happen, it is apparent that failure to plan will lead to job loss, devaluing of the housing market, out-migration, social problems, business closures deterioration of services and loss of municipal revenue (Marais, 2013b). Work by Siyongwana and Shabalala (2019) points to the sheer scale of social disruption which has occurred in mining towns following closure and the risks associated with the failure to transition workers and economies to new activities. Indeed, this paper highlights that some people will be unable or unready to transition. Ongoing funding will be required if activities are to be provided to ensure these people have a degree of engagement in society and a sense of being valued, to ensure that social dissatisfaction and unrest does not ensue. Challenges will also exist as communities will need to cope with declining infrastructure as the tax base may further reduce.

This all, unfortunately, suggests that developing resilience capacity through progressive processes of reskilling, reusing infrastructure and facilities and seeking new employment options, as noted elsewhere in the world as critical in order to transition mine towns and regions and their communities (Syahrir et al., 2021) is clearly not yet occurring in Mpumalanga. Failure to actively engage now in preparing communities and towns to transition and only engaging in high level policy planning at central government level does little to help those on the ground and is not strengthening regional adaptive capacity. Adaptive capacity is critical to the future of mining regions as Everingham et al. (2022) note with respect to addressing the impacts of closure, but as they also, worryingly point out, Africa's mining regions are often the least well-prepared to adapt as is apparent in the case of Mpumalanga.

In terms of regional resilience thinking and Evolutionary Economic Geography (EEG) theory (Pike et al., 2010; Boschma and Frenken, 2011; Martin and Sunley, 2015), it is difficult to escape the conclusion that, because of entrenched social and employment norms, the narrow skills base, the region's effective mono-economy, significant institutional and financial constraints, the lack of local vision and few viable economic alternatives, that the region is "locked-in" to its historical path dependence. There currently appears little opportunity and capacity for new "path creation," particularly since the only current option is the development of a renewable energy sector, which it is apparent will not replace all lost jobs and is currently being developed and promoted in other provinces and close to the platinum mining belt in the North-West province. Even to achieve this partial adaptation into the renewable energy sector will require having a regulatory environment that gives some comfort to new investors knowing that subsidiary funding will be reliably allocated and that contract breaches will be addressed. The community however need the assurance that environmental and local labor needs will also be addressed.

If a Justice Transition is to be achieved in South Africa and in Mpumalanga, significantly more will need to be done to translate high-level national policy pronouncements into concrete support to develop resilience in affected communities, through ensuring that investors protect the environment and local labor needs, skills development occurs and new enterprises are enabled through wayfinding and suitable micro-financing. Challenges will also exist for the maintenance of services which will be in decline. Housing challenges will occur with prices dropping and people relocating to informal areas. The meaningful engagement of citizens unable to find employment will need to be implemented and receive on-going funding, schemes may also be able to assist in the inevitable housing and service provision shortfalls. Empowerment may occur for some by entering income generating enterprise, unfortunately for others empowerment may occur *via* meaningful engagement rather than work.

Market forces will not automatically solve the region's economic and social problems given the region's effective mono-economy, and history of uneven economic development. Market forces are likely to abandon Mpumalanga's coal belt as a "lagging region" similar to what has happened in South Africa's gold mining areas

(Binns and Nel, 2003; Marais, 2013b). There is however some optimism as the European Commission's partners (EU, UK, and USA) are willing to contribute a substantial sum, however firm systems and agencies need to be put in place to ensure that the funds are appropriately utilized. Accountabilities also need to be in place, to offer security to other investors both big and small that they can operate in the region in a clear and easy manner, with any issues being addressed, without needing to compete with corruption, state capture or nepotism. This accountability and agency support with the addition of ongoing funding also needs to also be available to the left behind communities so they are empowered and enabled to do the best that they can and give real meaning to a Just Transition. This need for accountability and implementation will be hugely challenging in an area which has been struggling under the current structures. Leaving the question of which structures can realistically achieve such parameters.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by University of the Free State. The patients/participants provided their written informed consent to participate in this study.

Author contributions

EN and LM contributed to conception and design of the study. ZM conducted fieldwork and ordered the database. EN wrote the first draft of the manuscript. LM and ZM wrote sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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