

SOCIO-ECONOMIC CONSIDERATIONS FOR A PARIS AGREEMENT-COMPATIBLE COAL TRANSITION IN SOUTH AFRICA

POLICY PAPER

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KEY POINTS

- Coal has been integral to South Africa's energy system and economy for decades, but is increasingly uncompetitive and creates considerable risks – economic, social, and environmental - for the country.
- A Paris-compatible mitigation pathway will mean the phase out of coal in the power and liquid fuels sectors by 2040
- Given the high levels of poverty and unemployment in South Africa, energy and climate policy needs to contribute to a development pathway that addresses these socio-economic challenges
- A just transition is required so that coal dependent regions and workers are not stranded by the energy transition or by climate change policy
- A just transition also addresses the development challenges facing the country
- Transition planning needs to consider worker transition schemes, local economic resilience and the development of new sectors
- We outline proposed interventions that could form a just transition package for South Africa

Authors:

This briefing paper was prepared by Jesse Burton, Andrew Marquard, and Bryce McCall of the Energy Research Centre, University of Capetown.

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1	INTRODUCTION	3
2	SOUTH AFRICA'S ENERGY AND EMISSIONS PROFILE	4
3	SOUTH AFRICA'S PARIS AGREEMENT-COMPATIBLE PATHWAY	5
4	THE COAL SECTOR AND ECONOMIC DEVELOPMENT CHALLENGES	8
5	POLICIES TO MANAGE THE SOCIO-ECONOMIC ASPECTS OF COAL TRANSITION	12
6	CONCLUSION	19
	Endnotes	20
	References	22
	Authors and Acknowledgements	24

This paper is part of a series of policy papers on the coal phase-out produced by ERC (South Africa), IESR (Indonesia) and TERI (India). All papers are available on: www.climate-transparency.org



1. INTRODUCTION

South Africa's industrial economy was built on very cheap coal. The country's dependency on coal was entrenched in the 1970s with massive infrastructure investment in new coal mines, large coal power plants, coal to liquid fuels plants and a massive rise in coal exports – all developments that were very strongly supported by the state. In the decades since, dependence on coal for electricity, liquid fuels, industrial use and foreign exchange via exports, has been locked in via support for coal in general, and via specific interests, in particular through state-owned enterprises for electricity and transport and through economic development policy (see Marquard, 2006 and Burton, Lott and Rennkamp, 2018 for a review). These include significant state support for new coal-fired power plants, subsidies for new privately owned coal plants, public finance directed at coal mining and direct state involvement in coal extraction, as well as regulated prices for liquid fuels that protect the conversion of coal to liquid fuels.

This support coexists uneasily with South Africa's commitment to the Paris Agreement target of limiting warming to well below 2°C. Such a commitment means, based on various techno-economic analyses, that South Africa will have to fundamentally alter its pattern of coal extraction and use (Wright et al., 2017; Burton, Caetano and McCall, 2018). McCall et al. (2019) have shown that a phase-out of coal in the electricity and liquid fuels sectors is required by around 2040 for a cost-optimal Paris-compatible emissions pathway – but that the rapidly changing economics of renewable energy will drive much of this transition in the electricity sector regardless of national climate policy.

Nonetheless, the free market alone will not deliver the Paris Agreement. Since the launch of the National Climate Change Response White Paper in 2011 (DEA, 2011), much of the policy infrastructure for emissions reductions is under development or has recently come into force (for example, the Carbon Tax Act, which came into effect on 1 June 2019, alongside sectoral targets for emissions). However, South Africa's climate change mitigation policy infrastructure does not yet directly address those affected by a transition away from coal.

In light of the need for a rapid and ambitious coal transition, and given the high dependency on coal for energy and the economic reliance on it of particular regions, we outline some of the socio-economic challenges of the transition for South Africa. A credible plan to make this transition one that ensures a just outcome for workers and communities impacted by a transition away from fossil fuels and towards a sustainable economy is required. Indeed, a "just transition" is an explicit priority in South Africa's national climate policy, specified in South Africa's Nationally Determined Contribution (NDC), and in the Paris Agreement. We offer some initial thoughts on what the elements of a "just transition" policy package could include. These are based on findings from the Coal Transitions global research project, on ideas proposed by various South African stakeholders, and on projects already being undertaken.

Box 1

We base our interpretation of what constitutes a just transition on the ILO guidelines (ILO, 2015), which take at their core that a just transition is one that considers the interrelated economic, social, and environmental dimensions of sustainable development. The guidelines state that:

- "coherent policies across the economic, environmental, social, education/training and labour portfolios need to provide an enabling environment for enterprises, workers, investors and consumers to embrace and drive the transition towards environmentally sustainable and inclusive economies and societies."
- "These coherent policies also need to provide a just transition framework for all to promote the creation of more decent jobs, including as appropriate: anticipating impacts on employment, adequate and sustainable social protection for job losses and displacement, skills development and social dialogue, including the effective exercise of the right to organize and bargain collectively." And that
- "The following elements constitute a basic framework to address the challenges of a just transition for all: (1) The greening of economies in the context of sustainable development and poverty eradication will require a country-specific mix of macroeconomic, industrial, sectoral and labour policies that create an enabling environment for sustainable enterprises to prosper and create decent work opportunities by mobilizing and directing public and private investment towards environmentally sustainable activities. The aim should be to generate decent jobs all along the supply chain, in dynamic, high value added sectors which stimulate the upgrading of jobs and skills as well as job creation and improved productivity in more labour-intensive industries that offer employment opportunities on a wide scale." (ILO: 2015).

It is clear that those who are already excluded from the South African economy will have the least capability to manage either the impacts of climate change or the effects of a mismanaged energy transition. The development of transition policies is thus imperative to ensure that South Africa's low-carbon development pathway does not exacerbate existing economic fragility while also contributes to climate change mitigation and climate justice goals. Such policies need to address both the costs and risks for fossil fuel workers and communities of the transition while also addressing the broader development challenges facing South Africa.

2. SOUTH AFRICA'S ENERGY AND EMISSIONS PROFILE

South Africa's emissions profile is dominated by energy emissions overall (80%) and coal-related combustion emissions in particular. This results from South Africa's dependence on the fuel for energy: coal made up 67% of primary energy supply for the country in 2015 (DoE, 2015); 92% of electricity is produced from coal; and roughly 25% of liquid fuels consumption comes through the conversion of coal into synthetic fuels at Sasol's Secunda plant. The remainder is used directly in industry for iron and steel, cement and process heat, and a small portion is used residentially and commercially. The country is uniquely dependent on coal for primary energy among the G20 countries (Climate Transparency, 2019), highlighting both the energy challenges and the socio-economic challenges of mitigation.

South Africa's total coal production peaked in 2014 at 263 Mt and has since been stable at around 250 Mt per year. Most coal used – barring a small portion for the metals industry – is domestically produced in either the Central Basin (Mpumalanga Province) or the Ellisras Basin/Waterberg (Limpopo Province). Many mines, barring a few very large mines that produce specifically for Eskom and Sasol, produce for both the local and export market. Export revenues in these mines have historically led to lower local prices, as lower-grade by-product of beneficiation for export is used for power generation, and as rail line constraints essentially capped upward pressure on coal prices in the local market.¹

Exports play an important role in revenues for the sector; historically, exports accounted for 30% of coal production by volume but around 50% by value (Burton, Caetano and McCall, 2018). Several new mines opened in recent years have been targeted at the export market, which was delivering very high prices over the period 2017-2018. If export demand drops off, either due to economic factors or climate policy in large coal-importing countries (Oei and Mendelevitch, 2018), it will likely drive up local prices as producers may be forced to cover both capital and mining costs and rail take-or-pay contracts (Huxham, Anwar, and Nelson, 2019).

Historically, Eskom contracted the majority of its coal on long-term contracts from co-located mines. Increasingly, Eskom now purchases coal from many smaller producers with high transport costs associated with their contracts (Burton, Caetano, and McCall, 2018). The shift away from tied mines² (supplying only Eskom) was driven by political intervention in coal procurement and by Eskom's financial crisis. The utility is struggling to invest in the mines where it is liable for new capital expenditure, meaning that volumes from those mines have shrunk. This has increased the complexity of Eskom procurement and increased energy security risks. Eskom's cost of coal has increased dramatically – 300% in real terms – over the period 2000-2015, as more difficult mining areas are accessed and mining costs have increased faster than inflation, and also due to the contracting issues described above. Fundamentally however, this has made coal less competitive in relation to alternative forms of generation (Steyn et al., 2017).

The shifts in contracting have also led to ownership restructuring as major diversified miners have sought to limit their exposure to Eskom (Anglo) or exit the industry altogether (South32). This raises key questions about future access to capital for miners, especially unlisted and smaller mining companies, and on how best to optimally allocate capital under future export uncertainty and domestic demand decline.

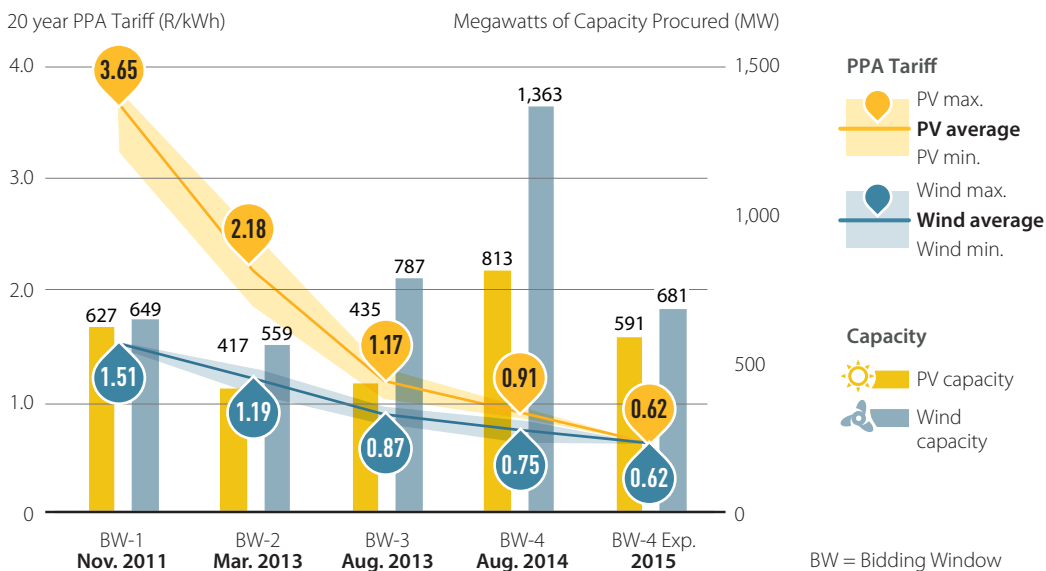
3. SOUTH AFRICA'S PARIS AGREEMENT-COMPATIBLE PATHWAY

Despite the coal intensity of South Africa's current energy system, changes in the relative costs of alternative technologies will lead to massive transformation of the South African energy sector over the coming decades. There is already significant transition risk facing the economy due to factors beyond South Africa's control (Huxham et al., 2019), for example policies and markets in large coal-importing countries such as India and China (Sartor, 2018). The following section outlines the expected decline in the future production and use of coal in South Africa, based on the technology cost reductions in markets for electricity and transport, and also due to meeting climate change mitigation imperatives under the Paris Agreement goal of limiting temperature rise to well below 2°C above pre- industrial levels.

On a purely techno-economic basis, coal is becoming increasingly uncompetitive in South Africa, in particular for electricity production. For example, levelized costs of electricity (LCOE) for Medupi and Kusile³ are estimated at R1.70 per kilowatt hour (kWh) and R1.90/kWh (2017 ZAR) (Steyn et al., 2017),⁴ (approximately 12.7 US cents/kWh and 14,2 US c/kWh).

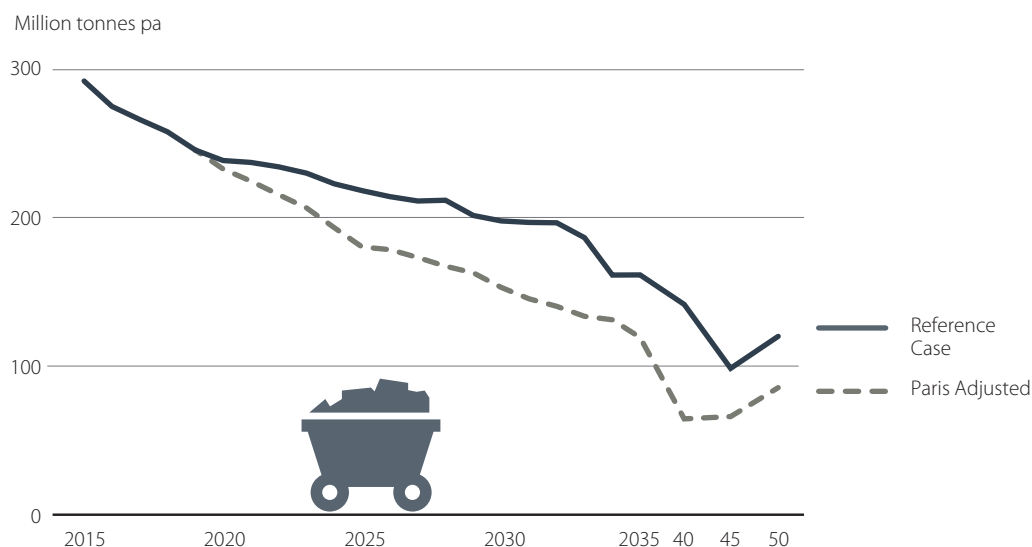
Tariffs at the privately owned coal plants Thabametsi and Khanyisa will, if built, cost approximately 40% more than the renewable energy bids received in 2015. Thabametsi's tariff is R1.03/kWh and Khanyisa's is R1.04/kWh (2016 ZAR), (approximately US 7 cents/kWh). Compared to the most recent bids received for wind and solar in 2015 (already out of date due to the stalling of South Africa's energy auctions for political reasons) at R0.62/kWh (2016 ZAR), it is clear why all credible analysis in South Africa shows a large uptake of renewable energy and no new coal or nuclear stations (from a system optimisation perspective). A least-cost pathway for South Africa (the reference scenario) thus shows a large reduction in coal use to 2050 (while not being entirely consistent with South Africa's fair share contribution to the Paris Agreement) (Figure 2). The analysis in McCall et al. (2019) clearly shows that the long-term structural decline of coal in South Africa is now inevitable on purely economic grounds, barring substantial state intervention to support the coal sector, either directly or indirectly.

Figure 1: **Historical solar PV and onshore wind Renewable Energy Independent Power Producer Procurement Program PPA prices and procured capacity for each round**



Ireland and Burton, 2018

Figure 2: **Coal production 2015–2050 in a least-cost reference and Paris-adjusted scenario**



based on analysis in McCall et al., 2019

In a scenario in which South Africa’s long-term domestic emissions policy is consistent with the Paris temperature goals (the “Paris-adjusted” scenario in Figure 2), an accelerated reduction in the use of coal is required in addition to the decline now evident in a least-cost pathway. In the Paris-adjusted scenario, South Africa would phase out coal in the electricity sector and in coal-to-liquids by around 2040. Industrial use of coal would continue to grow, however, as alternative commercial options for iron and steel and cement manufacturing do not yet exist, and alternative options for process heat are not yet competitive. Fuel switching in industry and policy packages to support manufacturing to transition to alternatives – for example, concentrating solar power, or natural or bio gas – require further study for South Africa.⁵

In the power sector, the Paris-adjusted scenario requires that new electricity generation capacity is a combination of wind and solar PV, plus flexible capacity such as battery storage.

In the Paris-adjusted scenario, total installed capacity is 113 GW by 2030 and 240 GW by 2050. Renewable energy technologies (wind, solar, micro-hydro and biomass) provide 62% of electricity generated by 2030 and 99% by 2050 (wind and solar together make up 57.3% and 96.3% by 2030 and 2050 respectively). This 20C-compatible pathway requires an accelerated investment in renewable energy in the medium term, particularly as more coal capacity comes offline in the 2020s or is run at lower load factors. There is still coal capacity available to the system in the long term from Kusile and Medupi, but not from Majuba, which is retired early. However, from 2026, Kusile operates at a 55% load factor and Medupi at 75% load factor. Neither station generates electricity from 2040 onwards, though they remain available to the system.

A decarbonised electricity sector is key to South Africa meeting the Paris temperature goal, since it offers the lowest-cost options for mitigation (Figure 4). An ambitious energy pathway will also require the retirement of coal-to-liquids capacity and the mass electrification of the transport sector. However, emissions growth in the industrial sector remains robust without policy packages to migrate industry to new fuels and modes of production.

McCall et al. (2019) demonstrate a feasible Paris-compatible techno-economic pathway for the South African energy system. Nonetheless, much of the debate in South Africa in the past centred on the technical feasibility of an energy transition, rather than the need for policies to manage the transition. This has shifted rapidly in the last two years (since Eskom’s announced closure of several power plants) (Strambo, Burton, and Atteridge, 2019) and has now started to focus on how the country can manage the transition. As the following sections will highlight, such policies need to encourage a transition that does not exacerbate economic fragility and that maximises the benefits of the transition. South Africa already faces a developmental crisis, and while coal plays a key role in the energy economy, the impacts of an energy transition will be far-reaching and often beyond the control of the South African state. Thus, transition policies for coal regions and communities need to be an integral part of South Africa’s climate change mitigation policy.

Figure 3: **Electricity generation by source (Paris-adjusted scenario)**

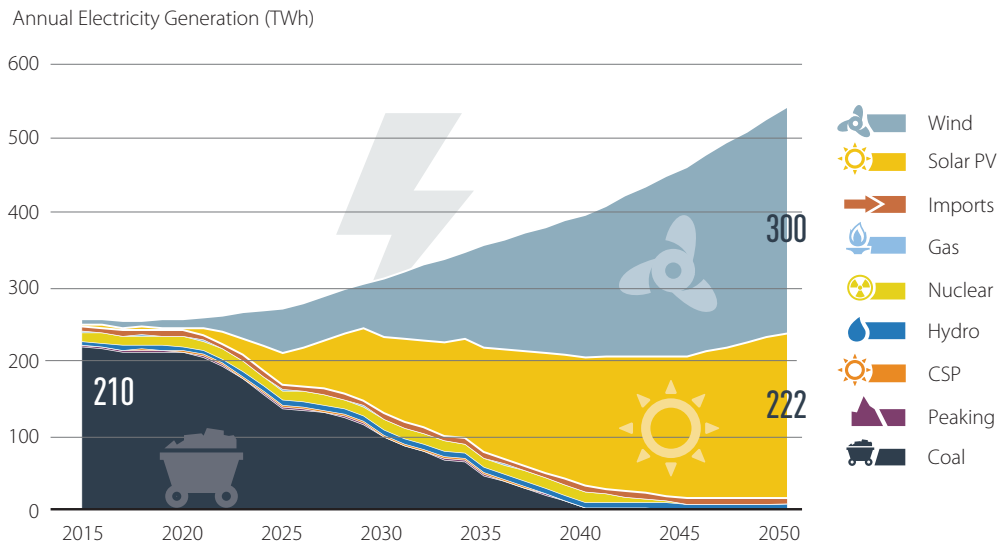
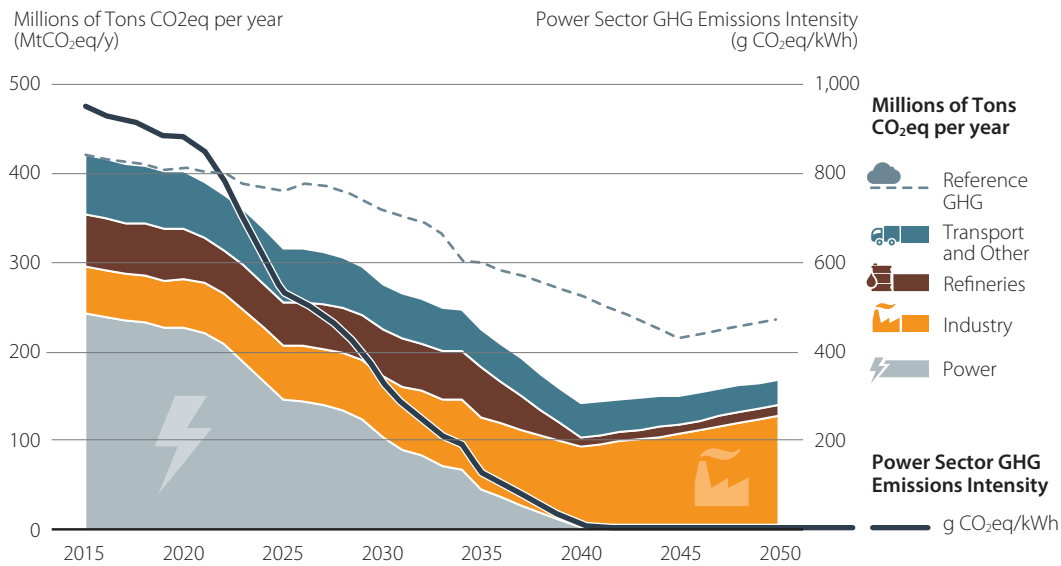


Figure 4: **Sectoral greenhouse gas emissions in South Africa (Mt CO₂eq) in a "well below 2°C" scenario**



4. THE COAL SECTOR AND ECONOMIC DEVELOPMENT CHALLENGES

4.1 National considerations: South Africa's development challenges

South Africa faces severe development challenges. Addressing them must frame any approach to its energy transition. In 2019 the narrow unemployment rate is 27.6% and the broad rate (including discouraged job seekers) is 38% (StatsSA, 2019); both are trending upwards. Youth (15–24 years) unemployment is 55%. In Mpumalanga, unemployment levels are higher than the national average at 34.2% and 43% on the narrow and broad measures respectively (StatsSA, 2019). More than 55% of people live in poverty and 25% live in extreme poverty – meaning they cannot meet their basic food needs (StatsSA, 2017). The education system is failing and according to recent analysis, 78% of South African Grade 4⁶ children cannot read for meaning in any language (PIRLS, 2016).

Many analyses have highlighted the mismatch between the structure of the economy – which is capital- and energy-intensive – and the need for a labour-intensive development pathway that reduces emissions, promotes employment and increases welfare (NPC, 2011; Winkler and Marquard, 2011; Altieri et al., 2015).

Fundamentally, the unemployment challenge has its roots in several structural features of the South African economy, all of which must be considered as part of the broader economic development agenda. The National Development Plan has identified these, and they include, among others:

- **education and skills deficits:** the poor-quality education system and lack of skills development alongside spatial patterns that exclude people from participating in the economy;
- **lack of integrated industrial policy:** deindustrialisation and low growth in labour-intensive sectors, lack of innovation and growth in new sectors;
- **infrastructure constraints:** poor infrastructure, including poor transport links, water provision, and energy constraints.

The fragility that characterises the South African economy means that any proposal that puts jobs at risk must be carefully considered, and points to the need for South Africa to ensure that its coal transition takes place in a context that promotes socio-economic development more broadly. Addressing the key constraints to growth in the economy will therefore be an integral component of any just transition plan for South Africa.

4.2 Coal in the national economy

Coal mining accounted for 2.3% of gross domestic product (GDP) in 2012 (van Seventer et al., 2016 in Strambo et al., 2019), but is a key input into many other sectors. Coal exports are a key source of export revenue, and accounted for around 12% of total merchandise exports from South Africa over the period 1993 to 2015 (CoM, 2016). In 2018, 49% of total sales of R139.4 billion were from exports (Minerals Council, 2019).

While the total tax take from the coal sector is not reported annually disaggregated from other sectors, in 2012, corporate and income taxes from the coal mining sector totalled R623 million (2012 ZAR) (van Seventer et al., 2016 in Burton et al., 2018). In addition to the payment of corporate taxes, companies have been required since 2014 to pay royalties, which have grown in recent years.

Table 1 **Royalties from coal mining, 2012/13–2017/18 financial years**

	Nominal Rand million
2012/13	No royalty
2013/14	392
2014/15	713
2015/16	702
2016/17	1097
2017/18	1637

Source: Burton, Caetano and McCall, 2018; Minerals Council, 2019.

According to the Minerals Council (2019), net investment in the coal industry has declined at a rate of 10% per year – from R7.3 billion in 2009 to R3.8 billion in 2017. This is despite high rand-denominated export prices over the period, large increases in the prices paid by Eskom for coal (though much of the price increases has accrued to the owners of coal transporting businesses), and large investments in coal mining by Sasol (Burton, Caetano and McCall, 2018).

Recent analysis has shown that between 2013 and 2017, South Africa already lost approximately R870bn (US\$60 billion) in future earnings from coal exports, driven by changes in global coal markets in terms of demand and prices (Huxham et al., 2019). This trend is likely to continue as Chinese and Indian demand for coal imports changes in response to energy transition dynamics in those countries. Such dynamics include the growing uncompetitiveness of coal versus alternatives, and energy, climate change, industrial, and air pollution policies that drive shifts away from coal (Sartor 2018; Spencer, Pachouri, Renjith and Vohra, 2018; Spencer et al, 2018; Fei, 2018; Vishwanathan, Garg, and Tiwari, 2018).

The ramifications of such global market and climate policy shifts for South Africa are enormous, and a mismanaged coal phase-out will increase economy-wide and sectoral risks for South Africa (Huxham et al., 2019). Not only are there financial risks associated with new high-carbon investments in electricity and liquid fuels, but also in associated sectors such as railways, mining firms and for the fiscus (where much of the risk eventually lands). Examples of risks include the following: the state-owned railway company Transnet faces considerable financial risks if coal exports decline in line with the Paris Agreement, with the entire Coal-Link business model becoming unviable in the early 2030s; large mining firms must now assess how best to deploy capital for mining under conditions of considerable uncertainty; Government faces exposure to its credit rating if development finance institutions, pension funds and others are not able to manage the financial risks associated with sub-optimal investments in coal infrastructure. In total, South Africa's climate transition risk totals R2 trillion.

Furthermore, coal mining, power plants and the associated industries are an important source of employment in the country. Figure 5 highlights how national employment in coal mining has changed over time, peaking in 1981 and declining in particular as the sector mechanised in the 1990s. The recent increases in employment in light of mostly flat output, are (we hypothesise), a result of two dynamics: firstly, Eskom's changed procurement structure, wherein cost-plus mines are producing at lower volume and these tonnes are being replaced from many smaller mines; and secondly, more difficult mining conditions in general across the industry increasing the labour-intensity of each tonne mined.

Figure 5 indicates that coal mining employment is projected to decline by more than half even under a least-cost energy future. In the Paris-adjusted scenario, employment declines more rapidly.

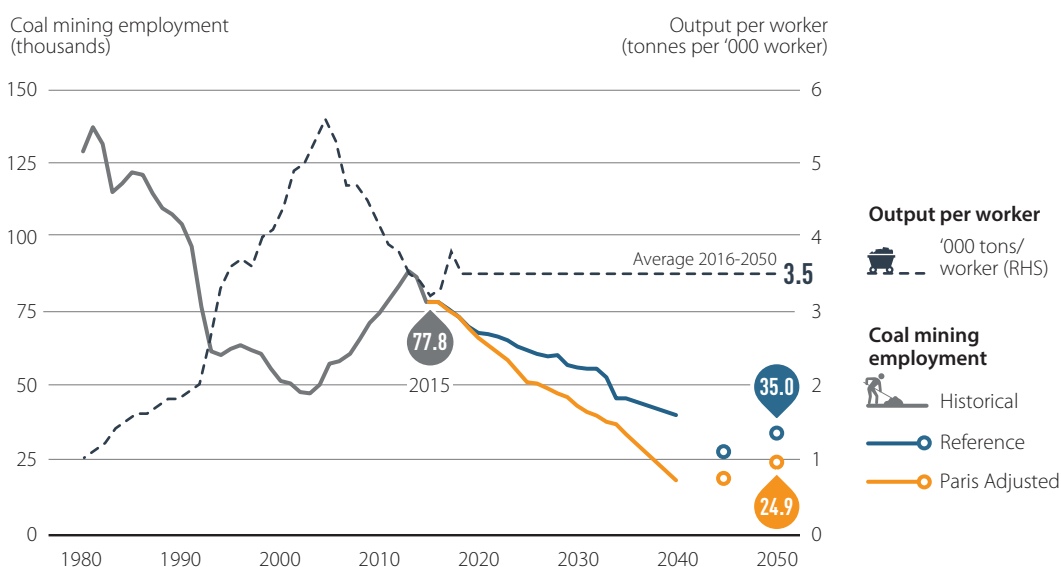
4.3 Coal region considerations

The major coal-producing province Mpumalanga is highly reliant on coal mining and coal power: coal mining accounted for roughly 19% of provincial value add in 2015, concentrated in the Nkangala and Gert Sibande district municipalities within the province (Strambo et al., 2019). In 2013, 72% of mining gross value added (GVA) and 58% of utilities GVA in Mpumalanga came from a single district municipality (Nkangala). A further 23.7% of mining GVA and 24% of utilities GVA came from the Gert Sibande District Municipality (Mpumalanga Provincial Treasury, 2015 in Strambo et al., 2019). For the province as a whole, coal remains an important "export"; in 2013, coal accounted for 25% of Mpumalanga's exports (Visser et al., 2015).

Coal mining is an important part of the Mpumalanga economy, accounting for around 7% of employment and coal miners typically support at least three dependants. Given the very high levels of unemployment in South Africa in general and in Mpumalanga in particular, transitional support is required for fossil fuel workers and communities. A key point is that the future projections highlight the extent to which transition planning is required for coal mining and related sectors, even without the implementation of more ambitious climate policy – job losses for coal workers are a risk already and these risks to livelihoods will grow as power plants and mines reach the ends of their lives. While renewable energy will provide more jobs in the electricity sector overall (Hartley et al., 2018), these may not be geographically located close to existing mining and coal areas, nor will they necessarily satisfy the wage and job quality demands of organised labour.

The following sections turn to a discussion of climate policy and mitigation policy in particular, how climate policy connects to transitional policies, and explores what some elements of a policy package to manage the transition might include.

Figure 5: **Historical (1970-2015) and projected (2016-2050) coal mining employment**



4.4 South Africa's existing climate policy

South Africa's climate mitigation policy framework is contained in the National Climate Change Response White Paper (NCCRWP) (DEA, 2011). In particular the NCCRWP defines a "benchmark emissions trajectory range" or "peak, plateau, and decline" (PPD) trajectory as South Africa's long-term emissions goal. This long-term emissions range targets a peak in greenhouse gas emissions in 2025 (between 398 and 614 Mt CO₂eq), a decade-long plateau, and then a decline to 2050 (a minimum level of 212 Mt CO₂eq and maximum of 428 Mt CO₂eq). The PPD range forms the basis for South Africa's emissions target range for 2025 and 2030 which is contained in its NDC. The PPD was established as the long-term national trajectory in 2011, prior to many of the cost reductions in low-carbon technology seen over the last decade, and has its analytical roots in South Africa's Long Term Mitigation Scenarios, finalised in 2007 and based on even older data.

Unsurprisingly, current emissions projections are very different. It is now possible for South Africa to achieve at least the high end of the range purely through cost reductions in renewable energy in the electricity sector (assuming renewable energy is built) and the currently planned retirement of coal infrastructure, especially large coal-fired power plants. The upper range of the PPD is not, however, considered a "fair share" contribution to a well-below 2°C compatible pathway, even under several equity considerations (Climate Action Tracker, 2019).⁷ The rapid techno-economic shifts which have taken place mean that meeting emissions reduction targets is far less costly than it was a decade ago, and especially for countries such as South Africa, in which the key problem in emissions reduction is shifting to low-carbon technology in the energy sector. As a result, investments made purely on the basis of cost (either through a market⁸ or through least-cost planning) would result in South Africa meeting the upper target of its emissions commitments without additional effort. However, as described previously, additional effort is required for a more ambitious and fair contribution to the Paris temperature goals.

The implementation of South African climate policy to meet this long-term reduction target has taken the form of three primary instruments:

- a carbon tax, which came into effect in June 2019;
- a carbon budgets system: the carbon budgets approach outlined in the NCCRWP will result in the direct regulation of large emitters, plus sectoral targets to be met through budgets and a range of other measures, based on the PPD;
- the Integrated Resource Plan (IRP) for the electricity sector, which is the basis for investment decisions in the electricity sector; the IRP contains an emissions constraint and is the basis for the procurement of renewable energy investment by the state.

The carbon tax has been championed by the National Treasury; the carbon budget system is being implemented by the Department of Environmental Affairs, which also has responsibility for overall implementation of climate policy, and the IRP is administered by the Department of Energy. The three main instruments have faced considerable opposition from special interest groups, organised business, and organised labour (Baker et al., 2015; Burton, Caetano and McCall, 2018; Rennkamp, 2019).

The release of an updated IRP – without which no further investment can be made in the electricity sector, despite shortages – has been delayed in negotiations for more than a year; the carbon tax came into force in mid-2019, but at what many commentators regard as an ineffectively low level⁹; and carbon budgets remain beset by implementation challenges, but are the central focus of the Climate Change Bill currently before parliament. While all three could provide opportunities and incentives for decarbonisation, they do not yet address coal extraction directly, nor the effects of reductions in extraction. Climate policy does not explicitly address either risks related to rapid emissions reductions for South Africa (such as socio-economic transition risks and the risk of stranded assets) or the potential co-benefits (more competitive electricity prices, reduced air and water pollution); nor does it consider the potentially regressive impact of the distribution of costs and benefits.

Yet the NCCRWP recognises a just transition towards low-carbon development as an explicit goal of South Africa's climate policy. A sector jobs resilience plan (SJRJ) is under development to examine the effects of decarbonisation on employment and the coal value chain; however, it is primarily a data-gathering exercise, and will not undertake any modelling nor propose particular decarbonisation and coal phase-out pathways. We therefore see an important gap in understanding and highlighting how the socio-economic transition can be managed to minimise harms to fossil fuel workers and communities while maximising the co-benefits of decarbonisation.

There are also tensions between mining and energy policy (which has promoted extraction of coal) on the one hand and on the other, climate policy (which at least indirectly leads to reductions in use, even if most changes thus far have been driven by economics). South Africa's economy is traditionally mining-centric: mining, and especially coal mining, has been an important component of the South African government's bid to promote black economic empowerment (Burton and Winkler, 2014; Winkler and Marquard, 2011). The mining industry is also a very important base for the union movement, and a coal phase-out may represent an existential threat to private sector unions (Strambo et al., 2019).

Mining policy does not yet make a specific climate-based distinction between coal mining and other forms of mining. A number of other government policies and programmes currently conflict with climate policy, and a far more integrated approach across government would be required if South Africa adopted a more ambitious mitigation goal. Currently conflicting policies and practices include:

- an expansion of the existing fossil fuel subsidy regime (primarily to Eskom) to support coal-fired electricity (indirectly stimulating demand for coal), but also the development of infrastructure to support coal mining in new areas (rail and water) (Burton, Lott and Rennkamp, 2018);
- the financing of new coal mines through state-owned financial institutions such as the Industrial Development Corporation, or African National Congress proposals for prescribed assets;
- direct ownership: the state-owned mining corporation African Exploration Finance and Mining Corporation mining firm has several coal contracts with Eskom;
- new coal-fired power plants “forced” into the IRP and requiring subsidies;
- mining regulations that permit mining in protected areas, and lack of enforcement of environmental compliance (e.g. water use licences, proper rehabilitation funds) and social compliance requirements (for example, community development contributions) (Strambo et al., 2019).

A key determinant of future coal production and use is the Integrated Resource Plan, which guides investment in the country’s electricity sector. The IRP as a result is now the primary driver for the future decline in coal production. However, since this is confined to the electricity sector, the IRP cannot address the complex suite of challenges which arise from a shift from coal power to other sources. These need to be addressed by not only a significant shift in energy and mining policy, but also by the development of an appropriate industrial policy. A less ambitious mitigation target (such as upper and mid-PPD) could probably now be accomplished piecemeal, and without significantly higher levels of policy integration (given the fall in renewable energy costs). However, it is extremely unlikely that a more ambitious mitigation target could be accomplished in this way without high political, economic and social risk.



5. POLICIES TO MANAGE THE SOCIO-ECONOMIC ASPECTS OF COAL TRANSITION

An exploration of each aspect of the overall policy package which in the longer term would be necessary to manage a rapid transition out of coal is beyond the scope of this paper. In this section, we focus on one aspect that is probably the most urgent short-term policy requirement for a successful longer-term transition – the policies and measures that are required to be put in place immediately to manage the coal transition for workers and local communities over the short-, medium- and long-term. These initiatives are compiled from issues raised in social dialogues (for example, the Mpumalanga meeting in the NPC Just Transitions pathways process), union low-carbon development principles and packages (COSATU, 2011), interviews with initiators of certain interventions, and a cursory literature review. This section provides some initial examples of what could be included in a just transition policy package, based on existing ideas and studies, but is by no means comprehensive.

One key feature of the South Africa political, social and economic landscape, as highlighted above, is very high structural unemployment. Any just transition package should therefore not only address the problem of potential unemployment and local economic decline due to the coal transition, but also address key development challenges including job creation and poverty alleviation over and above the specific coal-related challenges. We propose a starting point that is spatially bound and focused on Mpumalanga, and later Limpopo. It also starts with coal workers (who will be the first to feel the impact of unplanned closures) and mining-affected communities (who are already experiencing the negative effects of poorly regulated coal mining). The following section includes some insights from existing literature and experiences on how to manage workforce transitions and draws on insights on regional diversification strategies, plus specifically South African elements.

5.1 Elements of a just transition package

Previous coal transitions offer a growing number of examples of good and poor practices and of policies and measures that have been applied internationally to support fossil fuel workers and fossil fuel communities in the transition.

Firstly, Sartor (2018) in a synthesis of the Coal Transitions project, found that social dialogue is an important pre-condition for appropriately supporting workers and communities to manage the transition in a way that does not exacerbate existing socio-economic fragilities.

Secondly, the studies of past coal transitions in that project found that in broad terms transition assistance needs to consider both narrow and broad interventions that target both the creation of decent work opportunities for fossil fuel workers and broader economic development activities for coal regions (Green, 2018).

The latter is particularly important in areas with structural unemployment and high levels of poverty. Many of the lessons of past coal transitions come from developed countries with higher levels of economic diversification and social safety nets, or with the ability for the state to allocate considerable support to regions (as in the recent German Coal Commission process, or as in Spain). This makes the transition far more challenging in developing countries. On the other hand, in developing countries such holistic interventions are in any event *vital* to addressing the existing challenges of poverty and inequality. The coal transition may therefore offer an opportunity to drive structural change in such economies. South Africa has not been able to redirect its development pathway despite a multitude of policy documents outlining the structural constraints on the economy; perhaps the just transition can become the starting point of a much broader societal transformation.

Green (in Spencer et al., 2018) has developed the following typology of interventions for workers, regions and firms. Interventions can be classified as compensatory (backward-looking), structural adjustment (forward-looking but narrow), or holistic (forward-looking and broad).

Already, South Africa's Just Transition Pathways process, initiated and coordinated by the National Planning Commission, has hosted a series of social dialogues on visioning pathways for the economy. The final report is due in September 2019. The stakeholder meetings have started the dialogues necessary for a just transition. The Commission has proposed three important and immediate actions: planning for job losses and job absorption (the SJRPs); negotiating labour and social plans at closing power plants; and implementing pilot projects in two provinces. However, the dialogues need to be continued, scaled up to include more actors and communities at different scales, need to happen more frequently as the transition continues to unfold, and be connected to ongoing research and implementation of just transition policies. The specificities of sector interventions and worker transition plans need to be institutionally embedded and financed (NPC, 2019).

There are already many practical interventions to assist those who will be impacted by a transition away from coal. Below we highlight a few related to decent work and building inclusive and resilient economies in theory; the following section draws together several proposals already made that could be included in a specific transition package for South Africa.

Table 2 **Typology of interventions**

	1. No support	2. Compensation or grandfathering (backward looking)	3. Structural adjustment assistance (forward-looking, narrow)	4. Holistic adaptive support (broad)
Workers	No support.	Compensation for losses, such as redundancy payments, early retirement benefits.	Cash or in-kind assistance to retain or relocate; wage subsidies; targeted unemployment payments.	Workers are given strong support not only to find new jobs but also to maintain or develop new valued attachments (of the kind that cannot easily be compensated, e.g. work of a similar social standing, or in the same community.
Regions/ communities	No support.	Compensation for losses, such as resource transfers to lower levels of government to compensate for reduced tax revenue.	Affected communities/ regions are supported economically to diversify, e.g. via direct investment in public goods such as infrastructure or innovation; subsidies or tax incentives to businesses in growth sectors; technical assistance.	Affected communities/ regions are given broader social-cultural assistance, e.g. investment in social service provision or community cultural and recreational facilities.
Coal mining companies	No support.	Compensation for lost asset value or existing assets are 'grandfathered' into the new regulatory regime. State-subsidization of company liabilities (e.g. financial liabilities to employees; site remediation liabilities) can also be considered in this category.	Businesses are provided cash or in-kind assistance to adapt to the new policy/context, e.g. tied grants for technology upgrading.	

Soucre: Green, in Spencer et al, 2018

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5.1.1 Transition and decent work opportunities for workers

The Coal Transitions project found that many options to protect workers in the process of coal closures already exist (but that implementation of these interventions requires effort and resources). While the specific contextual factors are important in each country, understanding the labour market and the age, skills and educational profile of the workforce is an important and necessary first step.¹¹

In South Africa, we are yet to even see a credible decommissioning pathway for the Eskom fleet; the IRP contains dates that differ from Eskom's planned decommissioning dates and licensing conditions, units at some stations have been placed into cold storage due to economics or operational reasons already, and lack of maintenance has likely curtailed the lifetimes of other units considerably. Without an optimal retirement schedule and commitment, there is a lack of certainty which would be required for the interventions outlined above. Lack of information and transparency on future unit lifetimes, and contextual factors relating to the workforce are causing mistrust and uncertainty, adding to the challenge of smoothing and financing transition pathways.

Box 2

Possible interventions include

- Setting a timeline for coal phase-down and allowing existing workers to retire naturally.
- Providing a bridge to pension for older workers or offering voluntary redundancy packages.
- Supporting workers who have appropriate skills or are willing to retrain to take on alternative roles within the company.
- Developing regional worker transfer programmes to support the direct transfer and on-the-job retraining of workers with appropriate skills to move to an alternative local job.
- Redeploying: offering employees who may struggle to find work in other roles or sectors the option to transfer their skills to alternative coal-based sites with the company.
- Establishing integrated multi-purpose retraining programmes.

Source: Sartor, 2018

5.1.2 Building local economic resilience

In light of South Africa's high structural unemployment and low levels of growth, building economic resilience, regional diversification strategies, and developing new sectors will be of the utmost importance in South Africa's coal transition. Such interventions must be context-specific and will depend on key issues such as geographical proximity of coal communities to other centres of economic activity; the size of the coal sector in the local or regional economy (GDP and employment); the financial links between the coal sector and local government and provision of local services; and the degree of psychological attachment that workers and citizens have to the region. In Mpumalanga, any worker transition schemes as outlined above will need to be accompanied by growth in new and existing economic sectors, since there may otherwise be limited opportunities even for skilled workers.

Alongside these findings from previous coal transitions and industrial transformations, it is worth noting that the International Council on Mining and Minerals (ICMM) has also developed best practice closure tools to assist mines in the social transition processes that face firms, employees and mining communities (ICMM, 2018). The guidelines on social transitions in many ways mirror the broader interventions outlined above, but are focused specifically at the mine level. There are four main areas covered by the guidelines: planning, social transitions investments, social transitions costs, and processes/governance considerations.

Box 3

For coal regions looking to build their economic resilience and transition beyond coal, the Coal Transitions project identified a number of strategies that can be effective if well executed. These include:

- **“Related diversification”**: developing industries that are related to existing economic activities and industries but do not depend on coal.
- **“Smart specialisation”**: supporting the growth of economic activities that build on an assessment of the region’s strengths and competitive advantages. In coal regions, this could include existing power, rail or port infrastructure, land availability, cultural and industrial heritage, skills of the local workforce, existing industries with growth potential, etc.
- **Strengthening of local entrepreneurial networks**: creating or strengthening networks between higher education and training organisations, local companies and entrepreneurs, local government and organised labour, in order to identify and support the growth of suitable activities.
- **Improvement of local infrastructure**: to boost the local economic attractiveness of the region, increase opportunities for economic linkages to other zones of economic activity and employment, increase the productivity and growth potential of local industries, and create opportunities for former coal workers to stay in their regions.
- **Improvement of “soft attractiveness factors”**: to support re-investment in the area, underpin land value and thus the wealth of the local community, and limit or reverse demographic outflows.
- **Location of public sector activities in the region**: to mitigate demographic decline, provide additional economic demand for the region, and support the development of new strategic industries.
- **Location of innovation or energy transition projects in the region**: often regions with a strong link to the energy sector are keen to retain this as part of their local identity, and they may possess the infrastructure to do so.

Source: Campbell and Coenen, 2017

Experience from previous mine closure processes in South Africa (and elsewhere) has shown that the social context of mine closure is “complex and high risk, requires engagement over years, delivers few quick wins, and requires cooperation and understanding between internally and externally heterogeneous groups of people” (Stacey et al., 2010). The relationship between host communities and mining companies is integral but also often fundamentally characterised by a lack of trust. Long-term post-closure development is almost always a challenge, and a far greater one in developing countries.

The already considerable challenges related to mine closures are likely to be exacerbated by the declining competitiveness of coal and the implementation of climate change policy, both locally and in international coal markets. Existing social transition research, practices, investments and processes may need to plan for a more rapid transition, and will need to connect more actively to national policy processes on South Africa’s just transition for coal. Coal firms may be the least willing and able to acknowledge the coming challenges, and the challenges of multiple, rapid closures may exceed the capability of individual firms to ensure best practice social transitions.

Box 4

Key questions to ask about managing social transition at mine level

- Has the knowledge base been updated for social transition?
- Has a socio-economic impacts and opportunities assessment been undertaken to understand community capacity and opportunities for economic diversification?
- Have partnering opportunities been explored?
- Has messaging around closure been integrated into the stakeholder engagement programme? Has it been included in the initial approval/ permitting?
- Has a social investment programme been developed with a focus on sustainable post-closure programmes and implemented during operations or as early as possible?
- Are training programmes in place to facilitate upskilling employees for post-closure responsibilities and to improve their employability?
- Has a retrenchment plan been developed with consideration of staggering reductions in workforce and assigning post-closure responsibilities where possible?

Source: ICMM, 2018

5.1.3 Potential elements of a just transition package for South Africa

The table below contains potential interventions and elements for a just transition package for South Africa.

Firstly, while the worker transition aspects will require early attention, given the high structural unemployment in South Africa, such a scheme must be accompanied by regional diversification and structural shifts in the economies of the

coal regions. This is both to absorb existing coal workers and to provide options for people who are currently unemployed and excluded from the economy. Thus the package should address regional development challenges as well as specific challenges arising from declining coal production and/or mining closures.

Secondly, many actors, including but not limited to COSATU (2011), groundWork (2017)¹² and Mpumalanga communities (NPC, 2019), have drawn attention to the importance of “soft attractiveness factors” that should not be ignored, such as clean

water and air. They also point out that what many communities demand are jobs (and for unions, decent, quality work), food security, access to public transport and healthy environments. The importance of a focus on youth unemployment runs through most calls made by different stakeholders and has been recognised in government policy. We have included these in the table but further information and projects/options need to be identified as part of a package of interventions (alongside institutional reforms and financing options).

Instrument or goal	Rationale	Example where possible	Institutional innovation and financing option	Research required	Actors
1 Transition pathways and decent work					
Worker transition schemes for Eskom and coal mining employees	Skilled workforce, economic justice	See Box 2 above for an outline of process	Eskom/tariffs, mining houses, grant funding, national fiscus	Contextual factors on work-force age, skills, options/costs of early retirement, redeployment, retraining	Workers, Eskom and mining houses, other industrial players, CSMI ¹³
Workplace placement schemes/ support	Assisting unemployed youth to obtain skills for job interviews, practice, placements	http://harambee.co.za/ National Business Initiative's employability scheme	Grant/philanthropic funding, Youth wage subsidy scheme, Other		Unemployed youth, companies, unions, National Business Initiative

2 Location of innovation or energy transition projects; related diversification

New utility-scale energy infrastructure in former mining areas	Leverage existing transmission infrastructure and expertise	Geographical procurement of utility-scale renewable energy in former mining areas (coal and gold) ¹⁴	Innovation in REIPPPP ¹⁵ procurement rules required for locational allocation. Potential for municipal generation/ procurement. Commercial finance. Development Finance Institutions (DFIs).	Optimal capacity allocation, jobs created per GWh, skills needed, potential or pathways for existing power stations workers to migrate into new plants	Municipalities, SAREC ¹⁶ , DoE ¹⁷ , banks, National Treasury
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Instrument or goal	Rationale	Example where possible	Institutional innovation and financing option	Research required	Actors
3 Improvement of local infrastructure; location of innovation or energy transition projects; related diversification					
Residential rooftop solar PV ownership with feed-in tariffs	Income generation for low-income households and social ownership model	Feed-in tariffs provided for low-income households to sell electricity into the grid ¹⁸	Institutional innovation in energy markets at municipal/distributor level. Developmental finance for capital expenditure. Distributor subsidy/feed-in tariffs.	Cost-benefit, socio-economic and risk analyses. Technical/grid feasibility assessments.	Municipalities, Eskom, NERSA ¹⁹ , DoE, National Treasury
4 "Smart specialisation": supporting the growth of economic activities that build on an assessment of the region's strengths and competitive advantages. In coal regions, this could include existing power, rail or port infrastructure, land availability, cultural and industrial heritage, skills of the local workforce, existing industries with growth potential, etc. "Related diversification": developing industries that are related to existing economic activities and industries but do not depend on coal					
Renewable energy assembly and manufacturing	Paris-compatible pathway requires very rapid and high roll-out of renewable energy: 172 GW from 2020–2050. Leverage skilled workforce	No extant example in Mpumalanga, existing assembly and component capacity developed during REIPPPP but some closed/decreased after REIPPPP procurement hiatus	Procurement rule change to promote geographical localisation Commercial finance DFIs/concessional	GW allocation, jobs/GWh, skills needed, potential or pathways for existing power stations workers	SAREC, DTI ²⁰ , DoE, Provincial Trade and Economic agencies
Other manufacturing	Leverage Mpumalanga's close links to markets, good transport links, and experienced industrial workforce	Need research on place-based opportunities for Mpumalanga and potential competitive advantage in existing and new sectors Increased support for existing manufacturing capabilities	Concessional/developmental and commercial finance, dependent on sector analyses	Detailed analysis of economic, innovative and scientific potential ²¹ of different sectors, and need and options for incentives.	DTI, TIPS ²² , IDTT ²³ , Provincial trade and development, GreenCape
Agriculture and agro-processing	Leverage high potential arable land in Mpumalanga ²⁴ Increased water availability as plants close	Bio and fibre crops on rehabilitated land Agriculture value chain assessments and agro-processing hub (Nkomazi)	Concessional, DFI and commercial finance; industrial policy incentives	Detailed analysis of economic potential, required capabilities, investments and incentives (Dube et al., 2018)	Agbiz ²⁵ , IDTT/CCRED ²⁶ , Agri-SA ²⁷ , DTI, TIPS, Minerals to metals (UCT), MEGA ²⁸

Instrument or goal	Rationale	Example where possible	Institutional innovation and financing option	Research required	Actors
5 Improvement of local infrastructure; improvement of “soft attractiveness” factors; location of public sector activities in the region; smart specialisation					
Education and literacy	Address low literacy rates and long-term skills deficits	Teacher training for literacy, ²⁹ USAID Reading readiness programme ECD programmes Community college project University campuses	Grant funding Social and Labour Plans Socio-economic development spend from new RE plants in region Department of Higher Education and Training	Role of existing educational institutions and existing barriers	University of Pretoria and TUT ³⁰ Emalahleni campuses, Nkangala TVET ³¹
Rehabilitation of mining land, catchment clearing/ecological services	Legal requirement for mining-affected communities, address water scarcity and pollution etc. Utilise rehab funds for large-scale employment of local communities Potential for commercial opportunities in degraded land and agriculture	Mine Water Co-ordinating Body Green Engine Room Biofibre economy on degraded land Catchment clearing and ecological systems services for employment Grounded ³²	Mining rehab funds Concessional/DFI Commercial opportunities		Mine Water Coordinating Body, mining companies, Minerals Council, SETAs municipalities, unions, rehabilitation firms
Food security	Small-scale poultry and agriculture. ³³		Grant funding		
Integrated transport systems and spatial planning	Just transition means more than just a technology transition. Public transport is key to meeting mitigation and economic justice goals		Government expenditure DFI Commercial		

These pillars for the provision of better services (energy and mobility), for possible areas in which coal regions can create jobs and meet other important developmental objectives, still require planning and coordination across various stakeholders and scales. This includes working with mine-affected communities at specific mines and firms, with broader coal communities in coal regions, co-ordinating between coal companies and other firms, and between local government, provincial and national government, organised labour and non-unionised workers, Eskom and new energy providers, academics and civil society. Existing projects and programmes may need to plan for more rapid and unexpected coal phase-out driven by changing export markets, and the pressures this could bring to coal-affected regions.

6. CONCLUSION

Coal remains central to the South African energy system, even as alternative technologies have become more competitive, especially for electricity generation. Economics will account for much of the transformation of energy systems globally over the coming years, and already place South Africa's coal mining sector in transition. However, Paris Agreement-compatible emissions pathways will require precipitous reductions in coal use. Creating conditions for meeting ambitious emission reduction targets will in turn require an integrated approach to climate policy, energy policy, mining policy and industrial policy. A more integrated approach to climate and economic policy objectives will in turn have to take into account South Africa's overall development context and challenges – namely, unemployment and poverty.

In this context, a just transition is vital for the success of the economy and of mitigation policy, and has to be developed not only to address the social and economic consequences of the coal transition for workers and communities (the magnitude of which is potentially very great, and which is already being felt), but also to contribute to the broader development agenda of the country.

From international literature on coal transition policy can be gleaned several approaches for firstly, mitigating the impacts on workers and communities that depend on coal; and secondly, building regional economic resilience and enhancing the developmental outcomes of regions. The latter is key in South Africa which already faces high structural unemployment and high levels of poverty. The international approaches are compatible with many calls made by organised labour and civil society, although programmes, projects and practicalities need fleshing out. Already, many proposals exist that correspond to the approaches adopted elsewhere. These include worker transitions schemes, investments in infrastructure in general and in new energy infrastructure in particular, related diversification, smart specialisation strategies, and soft attractiveness factors such as programmes to address rehabilitation and land use, water and air pollution, and development needs such as energy and mobility services and food insecurity.

The current challenges are to enhance transparency and data; expand the list of potential projects and proposals that make up an implementable package for South Africa's just transition; connect and coordinate stakeholders working at multiple scales on coal closures, local economic development and national energy, education and development priorities; and finally, to assess financing options and challenges across multiple scales and types of policies and projects.

ENDNOTES

1. Eskom has claimed that in recent years they have experienced significant upward pressure towards export parity prices from producers due to higher export prices. While this may be true of some of the coal in the market, this is really due to two underlying structural factors: Eskom's failure to invest in co-located mines and their need therefore to contract on short/medium-term contract terms with producers while export prices are high; and overall reductions in capital investment in the sector, which is leading to underinvestment in new mining capacity on the supply-side and is exacerbating this dynamic (Minerals Council 2019).
2. 'Tied mines' refer to mines which produce coal under long-term contract only for the Eskom power plant located adjacent to the mine.
3. Medupi and Kusile are two very large coal-fired power plants under construction in South Africa by Eskom, with a planned capacity of 4764 MW and 4800 MW respectively.
4. This is higher than alternative estimates, e.g. <https://www.ee.co.za/article/understanding-cost-electricity-medupi-kusile-ipp.html> due to different assumptions on cost of coal and capital.
5. The uptick in coal use in the 2040s is a result of implementing the carbon budget over the model horizon (ending in 2050) and continued GDP growth in the industrial sector. Further work is required to extend the model horizon past mid-century and to evaluate pathways to achieve net-zero emissions.
6. Grade 4 is the fourth year of primary school in South Africa.
7. The Climate Action Tracker (climateactiontracker.org) aims to assess what are individual countries' "fair share" contributions to the global temperature goal contained in the Paris Agreement by assessing country contributions against a range of proposals in the literature for how to divide the global effort that is necessary to achieve the temperature goal fairly among countries.
8. The South African energy sector, and particularly the electricity sector, is currently highly regulated; however, planning follows a least-cost approach, with policy adjustments as applicable; and the government currently has plans to restructure the electricity sector, which may include deregulation of part of the sector.
9. The South African carbon tax came into effect from 1 June 2019. The tax is set initially at a rate of R120/ton (US\$9 in 2019), however, there is a blanket discount of 60% (bringing the applicable tax down to R48/ton (US\$3.5 in 2019), and further potential discounts for trade exposure, performance against a benchmark, conforming with the proposed carbon budget system and an offsetting scheme, which can bring the tax level down as low as R12/ton (US\$0.9 in 2019). The effective tax rate will therefore lie between R12 and R48 per ton. The tax will cover all sectors apart from land use, agriculture (non-fuel combustion) and waste.
10. In so doing, we are mindful of the competing ideas about what a just transition entails, and the extent to which it overlaps with broader calls for development that is people-oriented and transformative. However, if any and all development needs are covered in the just transition, it becomes practically much more difficult to implement – what may be gained in vision is lost in focus. There is no easy solution to what should be included, but defining what is included in the transition policy package will have to form a key component of ongoing social dialogues and be included as bottom-up proposals from workers, communities and companies impacted by transition.
11. Existing publicly available information in South Africa on coal miners is not sufficient for even this first-level analysis (Schers et al., forthcoming). The SJRP research may provide further insight into the profile of workers, and this will need to be modelled alongside different mitigation and coal closure pathways.
12. GroundWork's approach is for a just transition, "which needs to re-envision our economy and our society through a widespread, grassroots-based debate. We suggest that some starting points can be identified in a more equal and ecologically sustainable economy, based on people's solidarity that serves people's needs, not profit, such as • a new energy system based on socially owned renewables; • new jobs in renewables; • large scale restoration and detoxification of ecosystems injured by the fossil fuel economy on the Highveld; • a new and healthier food economy; • healthier and climate wise housing; • a new and healthier transport economy; • a reorientation and expansion of municipal services; • a basic income grant for all." (2017:180).
13. The Centre for Sustainability in Mining and Industry (CSMI) has developed locally specific guidelines for mine closure (Stacey, et al., 2010).
14. See for example, SAREC/SAPVIA (2019).
15. Renewable Energy Independent Power Producer Procurement Programme – South Africa's current programme for procuring new renewable energy generation capacity from private investors
16. South African Renewable Energy Council – an umbrella body of renewable energy industry associations in South Africa. See <https://sarec.org.za/>
17. The South African government's Department of Energy. In the aftermath of the May 2019 South African national elections, the Department of Energy was merged with the Department of Mineral Resources,
18. See Bischof-Niemz, 2019.
19. National Energy Regulator of South Africa
20. The South African government's Department of Trade and Industry

21. See, for example, the outline of the coal transitions strategy for Slovakia's Upper Nitra region: https://ec.europa.eu/jrc/sites/jrcsh/files/coal_regions_report_jrc_pilot-slovakia.pdf.
22. Trade and Industrial Policy Strategies, an independent economic policy thinktank in South Africa focused on industrial policy.
23. Industrial Development Think Tank, based at the University of Johannesburg.
24. See BFAP, 2012.
25. Agricultural Business Chamber, a South African agribusiness association.
26. Centre for Competition, Regulation and Economic Development, at the University of Johannesburg.
27. Agri-SA is a federation of South African agricultural associations.
28. Mpumalanga Economic Growth Agency, an economic development agency of the Mpumalanga provincial government
29. For example, the Reading to Learn initiative to train teachers (cost of approx. R50k per teacher) see <https://www.readingtolearnsouthafrica.com/>.
30. Tshwane University of Technology, in Gauteng province.
31. Technical and Vocational Education and Training colleges.
32. For example, <https://www.grounded.co.za/> a company that builds landscape companies which are structured as partnerships between NGOs, farmers and investors. These companies select the best ways and the best crops to restore the soils and biodiversity, while producers get assistance on regenerative farming practices and/or sustainable harvesting, alongside leveraging high-value agricultural chains.
33. See for example, Wong et al., (2017) who outline the key role of small-scale poultry in food security.

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Authors

This briefing paper was prepared by Jesse Burton, Andrew Marquard, and Bryce McCall of the Energy Research Centre, University of Capetown.

Contact: Jesse Burton (Burton.Jesse@gmail.com / Jesse.Burton@uct.ac.za)

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