WORKING PAPER

MINING VALUE CHAINS AND GREEN GROWTH IN SOUTH AFRICA: A CONFLICTUAL BUT INTERTWINED RELATIONSHIP

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Trade & Industrial Policy Strategies (TIPS) is a research organisation that facilitates policy development and dialogue across three focus areas: trade and industrial policy, inequality and economic inclusion, and sustainable growth

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MAIN CONCLUSIONS

1) The development of mining value chains is conflictual but deeply intertwined with the goal of sustainable development.

2) The response of mining value chains to the shift to a green economy cannot be business-as-usual and requires a proactive answer by business, Government, labour, non-governmental organisations and the research community in support of sustainable development.

3) The transition to a green economy will not fundamentally challenge the central position of mining value chains in South Africa's development path.

4) The development of green industries and services will generate considerable mining-related opportunities, which South Africa is ideally placed to seize.

5) The shift to a green economy will nevertheless structurally affect both the demand for mineral-based products, i.e. *what to produce*, and the means of providing them, i.e. *how to produce.*

6) While many mining and manufacturing companies are already vigorously investing in the green economy, most prospects on both the supply and demand side remain underexploited or untapped.

KEY POLICY RECOMMENDATIONS

1) A comprehensive strategic and integrated planning for the sustainable development of South Africa's natural resources should be developed.

2) Institutional and legal confusion around environmental regulations should be addressed while environmental and social 'licences to operate' should be adequately enforced.

3) The use of renewable energy and cogeneration and the improvement of resource efficiency, particularly in the area of energy and water, should be accelerated and further supported.

4) The interplay between industrial development, trade and green economy in South Africa should be better understood, particularly in terms of potential risks and opportunities.

1. INTRODUCTION

As the world grapples with multiple economic, social and environmental crises, sustainable development, notably through the transition to a green economy, has been acknowledged as the way forward. Such a paradigm shift would entail the transformation of the mining and linked manufacturing industries: these industries, which remain world basic activities for economic development (with agriculture), appear instrumental for any successful growth transition. In this respect, recognising the finite nature of mining activities and their fundamental economic role in the South African economy requires a move beyond the notion of mining value chains being unsustainable due to the non-renewable nature of the extracted resources. It shifts the

focus to how mining value chains can contribute to a green growth path, i.e. moving from a purely economic model (aimed at maximising growth) to an approach encompassing the four intertwined (economic, social, environmental and governance) spheres of sustainable development (IIED, 2002).

Mining value chains are at the heart of society's material quality of life, providing resources which are integrated in almost every product and service around the world. Mining and related downstream manufacturing industries also represent strategic drivers of growth and development, notably through their multiple forward and backward linkages with other key industries.

Table 1: Mining sector contribution to the South African economy in 2013

Indicator	Value / Percentage
Nominal direct contribution to GDP	R279.7 billion (8.3%)
Direct and indirect contribution to GDP	Around 17% (2012)
Contribution to total investment	12.2%
Contribution to private sector investment	19.4%
Contribution to total merchandise exports	R279.5 billion (30.5%)
Contribution to direct employment	510 099
Remuneration paid to employees in mining	R100 812 million

Sources: Chamber of Mines, 2012 and Chamber of Mines, 2013

In South Africa, as illustrated in Table 1, the sector has generated significant benefits to the economy and society, from increased output, revenues, investment, exports and foreign exchange, to employment, local economic development, training opportunities and new technologies.

At first sight, however, the transition to a green economy, which relies on the sustainable use of natural resources and the protection of the environment, implies a complex balancing act for mining value chains with direct short- and long-term consequences on the industry's business models, as well as modern economic and social structures. Parallel, a number of pressing priorities, such as labour issues, as well as the absence of incentives for reforms on the environmental front (such as a strong path dependency, the lack of support and the improper enforcement of regulations) have hindered the urgent sustainable transformation required in the sector.

The shift to a green economy will structurally affect both the demand for mineral-based products and the means of providing them

Given their scope and essential role to the economy and society, the transition to a green economy will not fundamentally challenge the central position of mining value chains in South Africa's (and the world's) development path. In addition, developing green industries and services will generate considerable mining-related opportunities. As such, South Africa's *National Development Plan: Vision for 2030* confirms that mining and related sectors will continue to feature prominently in the structure of the country's economy (NPC, 2011).

Nevertheless, the shift to a green economy will structurally affect both the demand for mineral-based products (in divergent trends depending on the ore), i.e. *what to produce*, and the means of providing them, i.e. *how to produce*, and will require proactive responses from the industry and government. In other words, acknowledging the intertwined but conflictual relationship between mining and sustainable development means adopting a prism of analysis that investigates the net long-term contribution of the industry to a green economy, considering both the contradictions and challenges, and the potential benefits and opportunities.

2. SUPPLY-SIDE IMPACTS: THE NEED TO FACTOR SOCIO-ENVIRONMENTAL CONSIDERATIONS

In line with developing social and environmental standards, meeting the demand for minerals and metals has raised important trade-offs and areas of contention around the operational model of the sector. These will be amplified with the move towards a green economy.

In South Africa, despite the elaboration and progressive strengthening of environmental regulations, mining operations and downstream activities continue to result in the pollution, degradation or complete loss of ecosystems, species' habitat and biodiversity, with detrimental consequences on local economic structures (such as agriculture and tourism) and communities (from a health perspective notably). The pollution of soils, air and water through waste disposal, emissions and wastewater or effluent discharge, in particular toxic, hazardous or radioactive wastes, illustrate the hidden costs of mining extraction (DEA et al., 2013). The most recurring and preoccupying issue remains acid mine drainage (AMD).[1] Owing to the interconnection of South Africa's water system, AMD has the potential to threaten the quality of the country's water supply (Kolver, 2013), with potential drastic environmental and social consequences.[2]

Further down the value chain, beneficiation activities additionally result in negative externalities, such as the release of heavy metals (lead, cadmium and mercury), silica and asbestos, leading to irreversible health and environmental consequences. Besides environmental considerations, mitigation actions required by the threat of climate change[3] have triggered the need for substantial changes in the mining sector and associated industries, particularly in energy use quantity and quality. Industrial emissions (including energy), which result from material processing,[4] constitute the

[1] AMD results directly from the excavation of rock to access minerals, essentially in the Witwatersrand Gold Fields, the Mpumalanga and KwaZulu-Natal Coal Fields and the O'Kiep Copper District.

[2] Mining companies are conscious of opportunities associated with reducing water consumption, through increased water efficiency, reduced production losses and reduced water charges. Mining operations can also provide local social benefits as a by-product of their own water needs, such as generating potable water (through purification) that can be supplied to local communities.

[3] South Africa has pledged to peak its GHG emissions between 2020 and 2025 at respectively 34% and 42% below a business-as-usual trajectory, plateau for approximately a decade and decline in absolute terms thereafter, subject to the adequate provision of financial resources, technology transfer and capacity building support provided by developed countries (UNFCCC, 2011).

[4] Material processing is defined as "the conversion of natural resources (ores, oil, biomass) or scrap into materials stocks which are then converted in manufacturing and construction into products" (IPCC, 2014a).

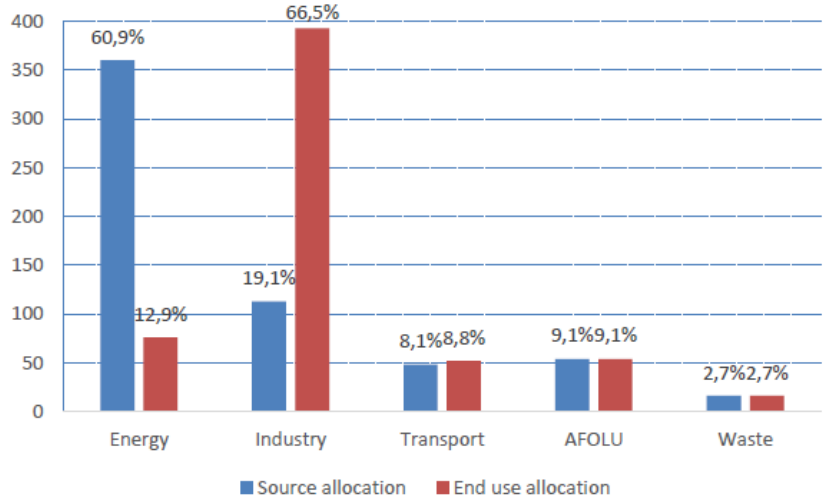
main driver of greenhouse gas (GHG emissions) in the world, accounting for over 30% of all GHG emissions, and continue to grow substantially, particularly in middle-income countries (IPCC, 2014b). Accordingly, South Africa's GHG emissions are heavily driven by the energy and industry sectors, incorporated in the country's Minerals-Energy Complex (Fine and Rustomjee, 1996), due to the country's reliance on coal for historically cheap electricity generation as well as the role of mineral resources and linked energy-intensive industries in the country.

Industrial emissions (including energy), which result from material processing, constitute the main driver of greenhouse gas emissions

As detailed in Figure 1, the energy and industrial sectors largely contribute to South Africa being the 13th largest GHG emitter in the world.[5] The consumption of a large share of the country's coal-based electricity (which results in 45% of South Africa's emissions) partly explains this. The mining sector consumes about 15% of national utility Eskom's annual electricity output, with gold (47% of the total) and platinum (33%) mining being the heaviest users. Further down the value chain, beneficiation activities, which require a large and uninterrupted supply of energy, consume a considerable share of the country's electricity. For example, BHP Billiton's aluminium smelters account for about 5.5% of Eskom's nominal capacity (TIPS, 2013).

In addition, the sector is partly accountable for rail, port and pipeline state-owned enterprise Transnet's emissions. As such, Sasol, BHP Billiton, ArcelorMittal South Africa, Anglo American and Anglo American Platinum are the main GHG emitters listed on the Johannesburg Stock Exchange (Incite Sustainability, 2012).

Figure 1: Sectoral breakdown of South Africa's greenhouse emissions in 2010



Source: TIPS, based on DEA, 2013

Note: Source allocation: Electricity emissions are allocated to the energy sector; End use allocation: Electricity emissions are allocated to end use sectors; AFOLU: Agriculture, Forestry and Other Land Use.

[5] Nevertheless, the country accounts for only 1.5% of global GHG emissions.

Against this background, some efforts have been made by mining and linked manufacturing companies, with the support of government, to reduce the sector's GHG emissions and energy consumption as well as its carbon intensity.

Mining and industrial sectors were assigned in 2005 an energy efficiency improvement target of 15% by 2015 (DME, 2008), as part of the National Energy Efficiency Strategy. Many companies (such as Anglo American, Anglo Coal, Anglo Platinum, AngloGold Ashanti, BHP Billiton, De Beers, Exxaro, Gold Fields, Implats, Sasol and Xstrata) have signed an energy efficiency accord with the Department of Energy (DoE) and Eskom. Some companies, such as ArcelorMittal South Africa (at its Saldanha Works) and Pretoria Portland Cement (at its De Hoek facility), are also pioneering in South Africa the implementation of the voluntary ISO 50 001 standard, the centrepiece of standards relating to energy efficiency and management (Bissoon, 2012).

Overall, changes in behaviour and processes have unfortunately been insufficient to meaningfully alter the sector's energy/carbon profile. Essentially driven by financial and strategic motivations,[6] companies across mining value chains have primarily adopted traditional solutions, such as load shifting and diesel-run back-up generators, as well as low-cost, low-hanging fruits in terms of energy efficiency (i.e. the optimisation of non-core activities and processes).

Changes in behaviour and processes have unfortunately been insufficient to meaningfully alter the energy/carbon profile of the sector

Some pioneering mining-related companies, which are investigating deeper, game-changing innovations around the implementation of new energy-efficient technologies and designs,[7] however, are demonstrating the range of technologies already available and the existing untapped potential in the field (Montmasson-Clair and Ryan, forthcoming).

Complementing energy efficiency initiatives, a limited (but growing) number of mining companies are seizing the opportunity to optimise their supply of energy through alternative sources of production, such as cogeneration and renewable energy. Cogeneration is generally the first entry point, particularly at the beneficiation stage, due to the quick benefits the process can bring to companies in mining value chains (on energy use, GHG emissions and financial fronts) (DoE, 2010). Scaw Metals, Exxaro and Anglo American Platinum are examples of companies that have gone such route. Furthermore, gold and platinum mining firms, such as AngloGold Ashanti, Harmony and

[6] Productivity improvements, cost savings, improved energy security, lower taxation costs, reduced vulnerability to energy price increases and climate change response measures, better reputation and ultimately freeing up resources for alternative investments are a few examples.

[7] For example, junior platinum producers Pallinghurst and Bramore Platinum have pioneered new production processes (the Kell and ConRoast process respectively) with substantial energy savings potential (Ryan, 2014). AngloGold Ashanti's innovative reef-boring technology and Evraz Highveld Steel and Vanadium's new through sizing methods are other illustrations. Hybrid industrial energy insulation, combining traditional insulation techniques and a cutting-edge paint technology, is another technology which is being used by some companies, such as Gold Fields, BHP Billiton and Impala Platinum.

Anglo American Platinum, have been investigating the use of the deep shafts and water gravity to generate power in underground mining.

Companies are also increasingly looking at renewable energy-based options. For example, chrome miner Cronimet invested in a 1-MW off-grid solar photovoltaic facility to complement diesel-based generators at its Thabazimbi mine. Exxaro established independent power producer Cennergi through a 50/50 joint venture with Tata Power to invest in projects under the government-run Renewable Energy Independent Power Producer procurement programme (Montmasson-Clair and Ryan, forthcoming).

Compounding environmental impacts (and their associated developmental consequences), mining activities have resulted in detrimental social externalities. Mining activities, despite contributing significantly to the country's and communities' development, do not necessarily boost growth in an inclusive and sustainable manner, owing to *inter alia* low labour intensity in some sub-sectors, precarious and indecent employment, the use of mostly imported technology, high market volatility of minerals, competition (during and after mining operation) with agricultural, forestry and tourism sectors, and institutional corruption and mismanagement. Benefits are not always equitably shared and surrounding communities can suffer negative externalities.

Indirect consequences linked to an increased colonisation of an area can also jeopardise the fragile equilibrium of (generally rural) communities, contributing to increased social problems, particularly at a local level, such as alcoholism, prostitution and sexually transmitted diseases. Mining activities can also displace communities with serious social problems, such as marginalisation, food insecurity, loss of access to common resources and public services, and social breakdown (WRI, 2003).

In brief, South Africa's mining value chains face significant supply-side challenges to adapt to the new social and environmental paradigms introduced by the transition to a green economy. Notably, existing initiatives remain insufficient to fundamentally alter the social externalities and the resource consumption profile of the sector. Mining and linked manufacturing companies will remain large, intensive energy and water users, heavy GHG emitters, and socially-disruptive operations for the foreseeable future.

3. DEMAND-SIDE CHANGES: AN ALTERATION IN THE MINERALS AND METALS REQUIRED AND TRADE PATTERNS

In addition to influencing the production process of mining and linked manufacturing firms, the transition to a green economy will alter the requirements and demand for minerals and metal products from South Africa.

Going against popular belief, while reducing environmental and social externalities and generating higher GDP growth and employment creation at the national level, a greener path in South Africa would have an overall neutral impact on the mining sector (UNEP and DEA, 2013). Although some mining value chains are likely to be negatively affected by the transition in the short term, such as the coal sector, other mining-related

industries are well placed to benefit from climate change mitigation measures and the development of greener economies in the long run.

Many opportunities exist to balance commercial risk with opportunity, and to shift mining-related production emphasis with changes in global demand (Camco and TIPS, 2010; WEF and Accenture, 2014). While the net impact of a greener economy on the demand of minerals and metals compared to the current situation remains largely not understood, clear opportunities can be identified in resource efficiency (in buildings and transport) and energy.

Mining-related industries are well placed to benefit from climate change mitigation measures and the development of greener economies in the long run

The mining sector is set to benefit from the global move towards renewable energy (estimated to rise by 40% over the next five years according to the International Energy Agency), given that renewable energy technologies are built from minerals, of which South Africa is a major producer. "[S]olar and wind facilities require up to 15 times more concrete, 90 times more aluminium, and 50 times more iron, copper and glass than fossil fuels or nuclear energy" (Vidal et al., 2013, p. 895).

Wind turbines notably use copper for wiring, cobalt for magnets, aluminium, metallurgical coal, iron ore, steel and zinc for towers, and silica sand for cement (Hodder, 2010). Similarly, solar panels require copper for wiring and cells, aluminium, coal, iron ore and steel for the frames, lead for batteries, and titanium dioxide for the panels (Muhovich, 2010).

Owing to high amounts of fertilisers and capital goods required, biomass energy is estimated to use around five times more iron per kilowatt-hour of electricity produced than regular fossil fuel-based electricity and is also expected to contribute to an increased consumption of the metal (ICMM, 2012a).

Other low-carbon technologies could also constitute major opportunities for some mining value chains in South Africa.[8] These include fuel cells (an energy storage and conversion technology that could notably power electric transport), which require a number of metals as catalysts (such as zinc, aluminium, platinum and magnesium), and the increased demand resulting from progress in hydrogen energy (DST, 2008).

Nuclear energy is also forecasted to increase despite recent incidents as more countries try to reduce their GHG emissions while ensuring the reliance of energy supply. South Africa would be well placed to supply global markets, thanks to substantial uranium and thorium reserves and the production of metals (to be used as catalysts).

Even the coal industry could benefit in the long run, should carbon capture and storage technologies become viable. While maintaining coal as part of a greener energy mix, the

[8] Anglo American Platinum showcased this technology in 2011 and has invested in research and development opportunities in South Africa to accelerate the use of fuel cells.

technology would also increase metal requirements due the additional infrastructure needed to capture, transport and store/reuse carbon dioxide (CO_2) (ICMM, 2012a; WEF and Accenture, 2014).

The drive for energy efficiency throughout the economy, particularly in buildings and transport, is also likely to generate new opportunities for mining value chains in South Africa. Minerals and metals are crucial in the infrastructure of buildings and their energy profile. For example, new advanced technologies relying on minerals and metals to insulate buildings will further increase the demand for mining products.

Many opportunities also exist in the transport sector. Hybrid cars still require significant amounts of chromium, manganese, molybdenum, aluminium, iron ore and coal for the body of the car; copper, gold and platinum for wiring and circuitry; and cobalt, lead and nickel for batteries (Wiechman, 2010). Similarly, lighter and more fuel-efficient vehicles require higher strength steels (containing niobium or molybdenum) and lighter metals, such as aluminium and titanium.[9] The increasing electrification of the transport system (through electric cars but also railways, tramways, trolleybuses and electric buses) will also stimulate demand for numerous metals produced in South Africa, including copper, zinc, nickel and steel (ICMM, 2012a).

Last but not least, manufacturing catalytic converters for automobiles remains a major opportunity. Catalytic converters drive 40% of the global demand for platinum, a mineral of which South Africa holds 75% of the global reserves, and the industry accounted for exports of R16 billion in 2012 (Chamber of Mines, 2012).

As car sales keep increasing worldwide and environmental regulations for automobile CO_2 emissions are being progressively strengthened, further opportunities exist to manufacture catalytic converters domestically, providing the right incentives and support mechanisms are implemented by government.

The impact of climate change regulation constitutes an important area of concern for South Africa's international competitiveness and access to markets and finance

In contrast, the impact of climate change regulation (both domestically and internationally), particularly carbon pricing, constitutes an important area of concern for South Africa's international competitiveness and access to markets and finance. On the one hand, the internalisation of the cost of externalities (such as GHG emissions) may impact the competitiveness of local industries (thus leading to reduced employment, revenues) compared to firms located in countries with less stringent (or no) carbon policies. Implementing domestic climate change mitigation measures, such as carbon taxes and carbon budgets, could have an adverse effect on local industries.

On the other hand, there is growing concern that measures already adopted, or measures that will be introduced by (developed) countries to mitigate climate change,

[9] South Africa launched the first titanium pilot plant at the Council for Scientific and Industrial Research in June 2013 as part of a strategy to position the country as a major titanium producer (Pretoria News, 2013).

could be trade distortionary and discriminatory, introducing new forms of green protectionism.[10] Furthermore, as increasing volumes of local and international financial flows are directed at the shift to more sustainable practices, the continuation of unsustainable business operations could jeopardise the access to financing in the medium to long term.

While a sectoral approach is required to properly understand trade and climate change impacts on business in South Africa and risks involved in international markets, a number of macroeconomic factors increase the vulnerability of the South African economy to climate change-related risks (TIPS, the dti and IDC, 2013). First, South Africa remains one of the most energy-intensive economies in the world and the 13th largest GHG emitter.[11] Comparing South Africa with larger producers, such as China, on a scale basis, the country would appear less at risk to climate change measures. However, it is important to consider South Africa's vulnerability (which is not diminished by scale) not only in terms of production volumes but also production processes and the excessive reliance on coal-based electricity.

Second, owing to the country's geographical distance from key trading partners, South Africa is the second most vulnerable country, after Chile, in terms of nautical distance weighted by bilateral trade (Monkelbaan, 2011). In addition, not only does South Africa have a high ratio of trade to GDP, ranging between 50% and 60%, but its exports account for 45% of the country's GHG emissions, which is significantly higher than the world average (Peters and Hertwich, 2008).

Third, despite persisting internal social challenges, South Africa is more likely to be targeted by green protectionism than many other developing countries, due to its classification as an emerging economy and as an upper-middle-income country. Indeed, exemptions at the international (i.e. World Trade Organization) level are likely to be granted solely to low-income countries and, to some extent, to lower-middle-income countries (Tamiotti et al., 2009). The absence of domestic economy-wide carbon legislation (although this may well change from January 2016) further increases the country's vulnerability to response measures.

These three factors render the South African economy particularly vulnerable to both domestic and external climate change-related measures. Comparing the potential impact of domestic measures against international ones is difficult. One key advantage of introducing a domestic carbon pricing must nonetheless be emphasised. It would

[10] This term refers to the justification of protectionist measures under the guise of addressing climate change and environmental goals. Trade-related examples of climate change response measures (potentially) impacting South Africa include explicit border carbon taxes and charges on exported goods that have not been covered by any carbon pricing regime or regulation in their domestic jurisdiction, as well as more implicit measures, such as subsidies, non-tariff barriers (phyto-sanitary measures, labelling schemes, standards, supply chain greening requirements) and regulations of bunker fuels. Modelling exercises suggest that minnig sectors (such as non-ferrous metals, coal, iron ore and steel), paper, pulp and print, chemical and petrochemical and textiles, could be severely impacted by border carbon adjustments from the United States and the European Union (Cosbey and Wooders, 2011; Du Plooy and Jooste, 2011).

[11] Based on data on carbon intensity of major economies in 2011 (in tCO_2 per 1 000 GDP in purchasing power parities, using 2005 US dollars) from the Energy Information Agency.

allow for generated revenues to be recycled in the economy, hence reducing the financial and economic impacts of carbon pricing on the country, while foreign taxation and restriction of South African exports would have detrimental uncompensated consequences.

In the end, the transition to a green economy has therefore a more nuanced impact on South Africa's mining value chains than generally considered. It carries both substantial opportunities and risks and commands a pro-active response to be successfully apprehended and managed.

POLICY IMPLICATIONS

In the light of these two underlying trends on demand- and supply-side dynamics, which have been impacting the mining industry, and will continue to do so in a greener future, a set of policy considerations emerges that will maximise the contribution of the sector to sustainable development while minimising negative externalities.

First, the lack of comprehensive strategic and integrated planning for the sustainable development of South Africa's natural resources, compromising the country's economic and social growth and potentially jeopardising the sustainability of the country's natural capital, should be urgently addressed. In identifying and developing South Africa's natural resources in a given region, government in collaboration with relevant stakeholders must consider the expected long-term national objectives, outcomes and return on investment, from an economic, social and environmental perspective.

The financial sustainability of mining in a given area, the associated long-term social (such as number of jobs, skills development, education opportunities, social projects) and environmental returns, and the assimilative capacity of the receiving environment should all be equally considered to determine: (a) the best use of natural resources for a given area to ensure the most sustainable long-term economic, social and environmental returns; and (b) should mining be the best use of natural resources, the most suitable way to mine a given area to ensure the most sustainable long-term economic, social and environmental returns (Parramon-Gurney, 2013). Only by clearly considering all these factors will the desired national returns be realised.

Only a strategic and integrated national perspective will inform and direct the sustainable development of South Africa's natural resources

Only a strategic and integrated national perspective, i.e. not driven by individual projects and considerations, will inform and direct the sustainable development of South Africa's natural resources to avoid, or at least minimise, negative impacts on the environment and promote the implementation of better practices in a collaborative way while maximising economic and social returns in the long run.

Second, this long-term approach should be accompanied by the enforcement of environmental and social licences to operate. Based on the acknowledgment that many

negative environmental and social implications of mining-related activities are not included in traditional cost-benefit analyses, an extensive regulatory framework[12] has been developed in the last two decades to identify and mitigate these undesirable externalities. In other words, "a legal mining licence to operate is granted when the negative impacts are deemed to be well-defined and the mitigating strategies are adequate" (ICMM, 2012b).

Beyond this, the concept of a social licence to operate has been increasingly recognised by the sector as an essential attribute of success, and has encouraged mining companies to factor social considerations in their operations.

Implementation problems have undermined the initial objectives of the environmental regulatory framework

Despite regulations reflecting international standards,[13] these licences to operate are only effective to the extent that they are appropriately enforced. At present, implementation problems, allegedly linked to government's lack of capacity and coordination, have undermined the initial objectives of the regulatory framework (while also making compliance complicated and cumbersome for mining companies) (Blaine, 2013; Gore and Erasmus, 2013; Solomons, 2013; Tucker and Strydom van Dyk, 2012; Van der Want, 2013; Webber Wentzel, 2013).

Overall, environmental regulations from the issuance of licences to the closure and rehabilitation of mining sites are mainly not (properly) enforced. For instance, 6 000 mining sites remain to be rehabilitated, and water and air regulations are essentially not imposed due to government's lack of capacity.

The approvals of environmental impact assessments (EIAs) in the country also appear flawed owing to the absence of a verification process from government of environmental impact practitioners and the limited control of applications. Consultants conducting EIAs *de facto* do not operate independently (as they should) but work for

[12] This framework builds on the policy mandate enshrined in the 1996 Constitution (Section 24 of the Bill of Rights recognises 'sustainable development' as a human right). The National Environmental Management Act No. 107 of 1998 (NEMA) constitutes the cornerstone legislative text of the country's principle-based approach to sustainability and plays an instrumental role in the pursuit of green growth in South Africa. Beyond strictly environmental considerations, the Minerals and Petroleum Resources Development Act No. 28 of 2002 (MPRDA), promulgated in May 2004, is the main legislation regulating the mining sector in South Africa. The Act stipulates the broad environmental framework in which the mining sector must operate and stresses the need of an environmental impact assessment as well as an approved environmental management programme/plan before any mining operation (i.e. prospection, exploration, extraction and production) can occur. In addition to MPRDA and NEMA requirements, the mining sector is impacted by a number of other environmental requirements related to air, water, waste, heritage resources, protected areas, biodiversity and municipal planning. Social matters, pertaining to health, safety and employment conditions, remain of prime importance, as illustrated by recent social conflicts in the mining sector, such as the five-month strike in the platinum industry in 2014.

[13] Some loopholes nevertheless remain, such as the provision under the NEMA Section 24G, which allows mining companies to obtain an *ex post facto* authorisation against an administrative fine of a maximum of R1 million, thus paving the way for mining companies to start their operations illegally without specific considerations for the environment.

mining companies, skewing the implementation of environmental regulations. To ensure that consultants work for government and the benefit of the environment, international best practice is moving towards government appointing environmental impact practitioners on behalf of mining companies.

Institutional and legal confusion has further impeded the positive impacts of the regulatory framework and created uncertainty for companies operating in the sector. Confusion and protracted negotiations (since 2008) between the Department of Mineral Resources (DMR) and the Department of Environmental Affairs (DEA) on the competency of environmental regulations for mining activities have hampered the enforcement of the regulatory framework (Tucker and Strydom van Dyk, 2012; Van der Want, 2013).

A unified legislation removing the obligation to apply for a licence under every Act or component of the regulatory framework, with one integrated overarching process catering for the needs of both the DEA and the DMR, should be introduced to streamline and facilitate the implementation of the country's environmental regulatory framework, thus improving its efficiency and reducing compliance issues.

The establishment of the *One Environmental System* from 8 December 2014 constitutes a definite step in the right direction. Under the new system, the Minister of Mineral Resources is responsible for issuing environmental authorisations and waste management licences while the Minister of Environmental Affairs is the appeal authority for these authorisations. A fixed timeframe of 300 days (and a maximum of 90 additional days for appeal) was also set for the consideration and issuing of the permits, licences and authorisations. The formation of an Environmental Protection Agency could be considered to further integrate and streamline the implementation of environmental regulations (D'Oliveira, 2015; Greve, 2014; DEA, 2014).

Furthermore, the strength and central role of mining companies has created a dependence of the state on mining companies to implement some environmental management measures, particularly in the case of AMD. Regulations on AMD have come into force only recently and a long-term solution is still being developed by an Inter-Ministerial Committee. In the meantime, provoking the closure of Central Rand Gold's operations in the Witwatersrand Central Basin (which was found violating environmental and social plans) would have, for instance, jeopardised the only viable solution to addressing pressing AMD issues in the region.

Third, complementing a long-term view on sustainable planning and the enforcement of environmental and social licences to operate, the use of renewable energy and cogeneration to meet (at least partially) the sector's large electricity needs and the improvement of resource efficiency, particularly for energy and water, must be accelerated.

Reluctance at the firm level, rooted in technical and financial considerations (such as capital expenditure requirements, operational and implementation risks), behavioural characteristics (such as the lack of motivation and the path dependency to business-as-

usual) and execution capabilities (such as the access to finance, firm-specific decision-making processes and skills requirements) remain a problem area to be addressed by government and industry stakeholders (Maia, 2013).

Further consideration should also be given to the Green Economy Accord, signed in November 2011 by the South African government, business and social partners. The Accord highlights 12 commitments, covering *inter alia* renewable energy, energy efficiency, solar water heaters, green investment, recycling, public transportation and rail freight, biofuels, clean-coal initiatives, the promotion of localisation and green jobs and access to electricity for all (EDD, 2011), but its implementation remains erratic and broadly unmonitored.

Existing government programmes (by the National Cleaner Production Centre for instance), fiscal incentives (such as tax incentives for energy savings and energy efficiency improvements) as well as privately-run schemes (by the National Business Initiative for example) should be scaled up substantially to overcome these barriers. Concessional funding, from the Industrial Development Corporation notably, and research and development support by the Department of Science and Technology, which is available for green investments, should also be increased accordingly.

Additional support should be provided to the research, development and deployment of cutting-edge low-carbon technologies. As illustrated, much of the potential for innovative, low-carbon technologies for mining and linked manufacturing operations remains untapped. The facilitation and fostering of industrial cooperation, through clustering and collaborative actions for example, could provide a springboard for enhanced implementation (IPCC, 2014a).

Further space and support should be given to companies to invest in renewable energy, energy efficiency and greenhouse emissions mitigation actions

Further space and support should be given to companies to invest in renewable energy, energy efficiency and GHG emissions mitigation actions. Despite some assistance from government, notably in the form of the National Treasury offering an accelerated depreciation allowance for capital equipment used for renewable energy generation, ultimately little space for investment in renewable energy by mining and linked manufacturing companies is available.

The current electricity industry in South Africa, structured around Eskom as the single buyer of electricity, only allows off-grid generation and projects under government-run procurement programmes. The development of a willing-buyer, willing-seller model, at present limited to a single trading entity, Amatola Green Power, should be facilitated to allow the use of independent power producers by mining companies for grid-connected generation (Montmasson-Clair et al., 2014).

A more concerted and holistic approach (including binding resource efficiency targets and support mechanisms) should be adopted to promote and enable key industrial

energy efficiency improvements (related to improved lighting, compressed air, motors, thermal efficiency, steam system efficiency and heating, ventilation and air conditioning, as well as mine design, extraction processes and cogeneration) as well as water efficiency and recycling initiatives.

Last, but not least, more consideration should be given to the interplay between industrial development, trade and the green economy. The potential (negative and positive) consequences of both domestic and external climate change-related regulations on the South African economy remain insufficiently understood. Further mapping of the potential risks and opportunities triggered by the transition to a green economy is central to comprehending the associated trade-offs, designing the necessary short-term support programmes, and adequately positioning South African mining and industrial industries in global value chains.

More consideration should be given to the interplay between industrial development, trade and the green economy

On the one hand, if South Africa can garner an in-depth understanding of the demand pattern, which will emanate from the global transition towards a green economy and "marshal the adequate and timely responses through [industrial policies]" (Naudé, 2011, p. 1017), it is indeed in a position to benefit from the global shift to green growth.

On the other hand, the need to understand the cumulative impact of climate change measures and the qualitative shifts and pressures on a country like South Africa is critical. At present, both South Africa's government and business sector do not interpret green protectionism as a significant threat. Creeping protectionist measures that are not as obvious as tariff barriers, such as private labelling schemes and the greening of value chains, are possibly having a significant impact.

An in-depth threat analyses at the sectoral level related to trade and climate change is needed, as preparation is key to dealing with the associated risks. The focus should be on being prepared to deal with potential threats, which should essentially be factored as issues of risk. The importance of keeping track of how South Africa's trading partners respond to climate change issues, and the ripple effect on the economy, should not be underestimated.

CONCLUSION

The response of mining value chains to the shift to a green economy cannot be business-as-usual. Successful management of the global green transition will require short-term pragmatism and longer-term planning in the South African mining industry, linking business, government, labour, non-governmental organisations and the research community in support of sustainable development. Mining value chains and sustainable development enjoy a conflictual but deeply intertwined relationship. South African companies in mining value chains are in a strong position to take advantage of the transition to a green economy.

While many companies are already vigorously investing in the green economy, most prospects remain underexploited or untapped. Both the private and public sectors must act proactively to seize these emerging opportunities. Most notably, the role and shape of mining value chains in a greener South Africa, along with the required skills and investments, must be further investigated and understood. Only then will South African mining value chains be able to harness the opportunities created by these new markets and position South Africa as a green frontrunner.

FURTHER RESEARCH CONSIDERATIONS

1) The direct and indirect supply and demand impacts of the global transition to a green economy should be further investigated and unpacked.
2) The implications of the global shift to a green economy on the business model of mining and linked manufacturing companies need to be better informed.
3) Further research is required to inform the optimal policy package to support a positive contribution of mining value chains to the green economy.
4) More consideration should be given to the macroeconomic implications (industrial development, trade, job creation, balance of payment).

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