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Briefing Note 2: The mining value chain and decarbonisation

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This brief draws on a forthcoming TIPS publication, *Decarbonising the mining value chain in South Africa: Technological options for a low-carbon future*.

The mining sector is a cornerstone of South Africa's economy, contributing 6% of GDP and directly providing about 473 400 jobs in 2024. However, it is highly energy and carbon-intensive, relying heavily on fossil fuels for power and processes.

Analysis of the mining sector's emissions profile shows significant variation across commodities and operations. Coal production from open-pit mining is particularly carbon-intensive, emitting over 74 million tonnes of CO₂ annually and driving substantial downstream emissions. Underground mines have lower rates of emissions, but still rely heavily on electricity for hoisting and ventilation. For example, Gold Fields' South Deep Mine consumes nearly 500 GWh per year, with electricity accounting for 93% of its total carbon footprint. Similarly, iron and steel production remains highly carbon-intensive, generating more than 6.3 million tonnes of CO₂ annually. Another major contributor is aluminium smelting. South Africa's largest smelter consumes about 10.3 TWh per year, making aluminium one of the economy's most energy-demanding value chains.

The South African economy has historically been shaped by the interconnections between mining, heavy industry, and cheap coal-fired electricity, which has been conceptualised as the Minerals Energy Complex. The country remains the 14th largest CO₂ emitter globally, with mining and electricity generation among the primary sources of emissions. Coal remains central to key economic activities, despite its role as a major driver of greenhouse gas emissions, extensive land degradation, and air and water pollution, which pose serious health risks to vulnerable communities.

TIPS's research highlighted that many mining companies have sought to transition to renewable energy solutions in order to ensure a more reliable and affordable electricity supply while reducing emissions. The shift is supported by regulatory reforms that now permit unlimited private off-grid generation capacity without licensing. Electrification of mining operations that now require liquid fuels, for instance diesel-powered fleets and pumps, is another decarbonisation pathway. However, other technology options have not been adopted at scale due to concerns over reliability, technological maturity and the high initial cost of investment.

Government policy is central to mining decarbonisation, both as an inhibitor and an enabler. South Africa's climate policy landscape has expanded significantly, including the carbon tax, the Climate Change Act No. 22 of 2024, mandatory emissions reporting, and sector-level carbon budgets. These initiatives increasingly require mines to reduce emissions or face rising financial penalties. Still, implementation gaps remain. Electricity market reforms, grid connections and complicated wheeling agreements directly affect mining companies' ability to install or procure renewable energy at scale.

Decarbonisation requires analysis of multiple pathways to assess the trade-offs, timing, costs, technology maturity and risks. The paper found that policy measures such as the relaxation of licensing requirements and unbundling of Eskom signals government's commitment to transforming the energy sector and serve as incentives and encourage private support. However, stakeholders also point to inhibitors such as tariff increases, rising regulatory pressures, financing gaps and complex approvals

processes. The impacts of decarbonisation technologies also differ according to company size, location and mineral type. Labour representatives emphasise that current decarbonisation roadmaps lack clear strategies to assist workers to transit into new kinds of work. Planning processes often fail to quantify potential job losses or really empower workers and their communities, despite the potential for substantial socio-economic disruption especially in coal-dependent regions.