CASE STUDY 03

# Alternative Energy in Mining

## Problem description

Mining has a complicated relationship with renewable energy. Traditionally, the two might be viewed as rivals, with renewables such as solar and wind power vying for a slice of the Southern African energy grid, which is dominated by coal-powered and hydroelectric plants. However, energy-intensive mining operations find themselves in a Southern African energy grid that is struggling to meet demand, and as mining sites often find themselves isolated from the electric grid, there is increasing incentive for mining firms to venture into private production of electricity, in which renewable power generation can play a vital role.

This case study examines the extent to which renewables can play a role in providing energy for the mining sector. While it will look at Southern Africa more generally, focus will be placed on South Africa, as the country serves as an ideal microcosm of a mining-intensive, energy-constrained Southern African region.

Southern Africa's energy production is often unreliable and unable to meet demand. In comparison, Belgium produces over 10 times more electricity than the Democratic Republic of the Congo (DRC), despite having 56 million fewer people. Even with the most advanced regional infrastructure in the Southern African Power Pool (SAPP), South Africa has been forced to implement intermittent rolling blackouts, known as 'load-shedding', starting in 2008. South Africa's suppressed electricity demand for 2013 was 1 342 MW. Moreover, the entire SAPP region lacked 2 131 MW of capacity. Of the nearly 300 000 GWh demanded,[1] Eskom was able to generate just over 232 000 GWh.[2] This has had a significant impact on the mining sector, which is one of the primary drivers of the South African economy, contributing 4.8% of the gross domestic product (GDP) in 2013.[3] With ongoing delays in the erection of new power stations, electricity is desperately needed.

Confronted with load-shedding, mining companies face the unenviable choice of either reducing operations or turning to costly diesel-powered generators. With energy already accounting for around 20% of grid-connected and 30% of off-grid operating costs, the pressure of this additional cost can substantially erode profit margins and place pressure on the price of commodities.[4] Capital costs for renewables have dropped significantly, so renewable solutions are in many instances cheaper than diesel. The renewable energy team at the Canadian engineering company Hatch has indicated that integrating hybrid power solutions – such as adding wind or solar to existing diesel systems – can cut mining companies' energy costs by 10–20%.[5] The renewable energy independent power producer (IPP) developer, CRONIMET Mining Power Solutions, operates a photovoltaic (PV)/diesel hybrid system for a South African chromium mine that replaces 30% of the mine's annual diesel demand.

Renewable technologies are most attractive to mining projects in remote regions with little or no access to established electric grids. The pressure of inadequate supply has arguably

1 SAPP (Southern African Power Pool), 'Annual Report 2013', http://www.sapp.co.zw/docs/22867%20Annual%20Report%20New.pdf.

2 Eskom Holdings SOC Ltd, 'Integrated Report, 2014', http://integratedreport.eskom.co.za/pdf/full-integrated.pdf.

3 Statistics South Africa, 'Contributions of the annualised percentage change in seasonally adjusted real value added by industry to the annualised percentag\e change in seasonally adjusted real GDP', Fact Sheet, August 2014, http://beta2.statssa.gov.za/publications/P0441/GDP_Fact_Sheets_2ndQuarter2014.pdf.

4 The Carbon War Room, 'Sunshine for Mines: Implementing Renewable Energy for Off-Grid Operations', Research Report, March 2014, http://www.carbonwarroom.com/sites/default/files/reports/CWR14_MinesReport_singles.pdf.

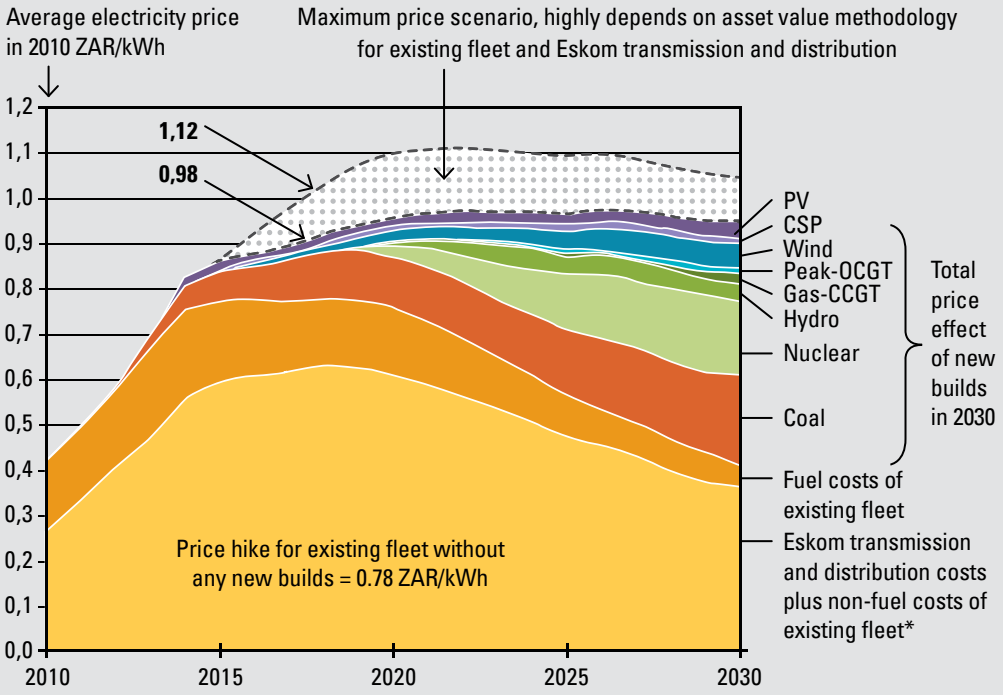
5 Energy and Mines, Thought-Leadership Hatch, 'Attractive economics and cost savings: Why mines are turning to renewables', Canadian Clean Energy Conferences, http://www.energyandmines.com/case-studies/.

shifted the dynamic of the mining industry's relationship with renewable energy, as firms increasingly turn to renewables as one component of a basket of energy options used to maintain stable power at mining sites.

### Box 1: The cost of renewables

Over the next decade, the price of coal-generated electricity in South Africa is expected to rise to ZAR[6] 0.78/kWh ($0.071/kWh).[7] In comparison, the third bidding window of the South African Renewable Energy Independent Power Producer Programme (REIPPP) has produced an average tariff for wind-generated electricity of ZAR 0.74/kWh ($0.067/kWh).[8]

**Figure 1: Breakdown of anticipated average electricity price path**




* Does not include costs of non-Eskom distribution network

Source: DoE (South African Department of Energy), 'Integrated Resource Plan for Electricity 2010–2030', p. 20, Government Gazette, no 34263, May 2011, http://www.doe-irp.co.za/content/IRP2010_promulgated.pdf

6 ZAR is the three-letter currency code for the South African rand.

7 DoE (South African Department of Energy), 'Integrated Resource Plan for Electricity 2010–2030', Government Gazette, no 34263, May 2011, http://www.doe-irp.co.za/content/IRP2010_promulgated.pdf.

8 The average ZAR/USD exchange rate for 2010 was 7.3 ZAR/USD and 9.63 ZAR/USD in 2013.

Solar PV was priced at just under ZAR 1/kWh ($0.091/kWh) which, although considerably higher than the current price for coal-generated electricity, is one-third the price of just over ZAR 3/kWh ($0.273/kWh) three years earlier.[9] The trend for all renewables in the REIPPP has been a decline in tariff prices for each bidding window.

## The case against renewables

While many advocates in the renewable energy sector see the reliance on diesel generators as making a clear case for a shift to renewables, this picture is incomplete. With mounting energy concerns in Southern Africa, large-scale energy infrastructure development projects are underway across the region, including the pending completion of coal-fired power plants at Medupi and Kusile and the future development of large hydropower projects in the DRC and Angola.

However, other players are being considered in the energy mix. The South African government, for example, has expressed interest in further developing sources such as nuclear power and shale gas (hydraulic fracking) in the Karoo basin. South Africa's shale gas reserve is the fifth largest globally and would be enough to drive more than half of the country's current electricity generation over a 20-year period.[10] Although currently speculative, the vast potential of 'bridging' alternatives to coal such as nuclear and shale gas are being seriously considered.

Given the sunk costs of diesel generators, the capital costs involved in setting up renewable projects mean renewable energy is still likely to be more expensive in the short term than diesel generation. This remains true whether mining firms develop their own renewable energy infrastructure or (as seems more likely) they turn to IPPs, who will price these costs into any agreements.

Private renewable energy installations, particularly solar power, do not benefit from the economics of scale available to large public projects. Factors such as increased unit maintenance cost and lack of geographic diversity mean that the economics of private renewable energy development is much less certain than for public projects.

9 DoE, *op. cit*.

10 Hedden S, Moyer JD & J Rettig, 'Fracking for Shale Gas in South Africa: Blessing or Curse?', Institute for Security Studies, *African Futures Paper,* 9, 2013.

### Box 2: Case study: Cronimet

There are already some cases of mining firms making use of renewable energy. Cronimet Chrome SA, a German-owned South African chromium mine, directly owns and manages a PV plant at a site in Limpopo. Cronimet Mining-Power Solutions GmbH – a subsidiary of the Cronimet Mining Group – completed, commissioned and continues to operate and provide advisory services to assist the mine in maximising energy efficiency from the world's first 1 MW ground-mounted diesel-PV hybrid electric power plant for industrial mining applications in South Africa. The diesel-PV hybrid facility produces about 1.8 GWh of electricity annually, or about 60% of the mine's annual daytime power needs. When comparing the construction cost of $2.66 million with the annual fuel savings of 450 000 litres of diesel consumption, this PV project boasts a break-even time horizon of just 3.6 years. The project also took only six months to complete, from planning to construction.[11]

According to Cronimet Power Solutions managing director Rollie Armstrong, 'not only has this successful commercial demonstration plant served as an invaluable test bed for our technology, it has been an industry catalyst and our showpiece, with interested customers coming from as far as Eritrea and Mali to view the equipment in action'.[12]

*PV installation at Cronimet chrome mine, Limpopo*

11 The Carbon War Room, *op. cit.*

12 Author's interview with MD Cronimet Power Solutions GmbH, Munich, Germany, 29 August 2014.

## Role of government

A critical determinant of the growth in renewable energies – especially in countries with a wealth of cheap hydrocarbon energy supplies – will be the active support of government. Aside from direct financial incentives such as tax breaks and subsidies, establishing a policy framework allowing alternative energy companies to either sell energy independently or feed electricity back into the power grid will produce excess capacity and help to diversify the domestic energy supply.

South Africa presently has a target of 10 000 GWh of renewable energy by 2013, with a further ambitious target of 21.5 GW of new installed renewable energy generation capacity by 2030.[13] A total of 64 projects have been awarded to the private sector, with some of the earlier projects already operating. Private investment totalling $14 billion has been committed. These projects will generate 3 922 MW of renewable power. The Department of Energy (DoE) has estimated that 3 725 MW has to be generated from renewable energy sources to ensure the continued uninterrupted supply of electricity.[14] The National Energy Regulator of South Africa (NERSA) originally proposed a renewable energy feed-in tariff for the procurement of South Africa's renewable energy. However, the DoE abandoned this in favour of a competitive bidding model, known as the REIPPPP.[15]

### Box 3: Green energy business models

Mining companies have managed to leverage their renewable projects into advanced roles as IPPs. Cronimet Mining Group is in the process of supplying six 5 MW South African PV projects as a part of the REIPPP programme.[16] The company began the engineering, procurement and construction contracting of Namibia's first and largest (4.5 MW) utility-scale ground-mounted PV system in Omburu on 18 August 2014.[17] The potential source of steady income, offsetting the high capital cost, has prompted mining companies such as Cronimet to explore one of four potential business models for distributed renewable energy.

13 DoE, 'Integrated Resource Plan for Electricity 2010–2030', Government Gazette, no 34263, May 2011, http://www.doe-irp.co.za/content/IRP2010_promulgated.pdf.

14 DoE, http://www.ipprenewables.co.za/.

15 In 2003, the South African government approved private-sector participation in the electricity industry and decided that future power generation capacity would be divided between Eskom (70%) and IPPs (30%).

16 Lazenby H, 'Six Cronimet projects progress to next South African IPP round', *Mining Weekly*, 10 March 2014.

17 Cronimet Mining Power Solutions, 'Cronimet Mining Power Solutions GmbH selected for 4.5 MW solar PV project', Press Release, 29 August 2014.

**Table 1: Green energy business models**

| Business model | Project development option |
|---|---|
| Self-generation | A mining firms develops, finances, and operates a PV plant on their own land |
| Self-generation and powering townships | A nearby community, close to the PV polant, gets government support to run a transmission line |
| Net metering | A grid-connected mine sells excess capacity generated by the renewable plant |
| Industrial pooling | A group of industrial firms enter into a long-term power purchase agreement (PPA) with a shared generation plant |

Further integration of renewables into the energy mix will require the expansion of policy incentives. A feed-in tariff would encourage investments from both large-scale energy producers and residential consumers. Removing subsidies of non-renewable energy sources such as coal would provide a more competitive environment for green energy sources. Currently the South African government through its competitive bidding process is able to establish IPPs in a parallel grid, usually in rural settings where fuel cost savings outweigh upfront capital costs. However, incentives such as net metering, feed-in tariffs or a carbon tax would attract mines to the energy grid to establish their own renewable energy systems and/or feed energy back into the grid.

## Political economy analysis

Implementing feed-in tariffs or net metering would require some fiscal outlay from government. In most parts of the region, this would be difficult to justify. Green energy is often viewed with scepticism in Southern Africa. Climate change is seen as a problem created in the rich developed world for which developing countries now have to pay. Green energy is also seen as undermining the competitive advantage of Africa's abundant supply of natural resources, including those used in energy generation. However, if renewable energy producers can demonstrate an economic benefit to end consumers and taxpayers in the form of competitive tariffs, public opinion is likely to change. Combined with job creation, this would be viewed as a win-win situation. While incentivising private investment in renewables will be easier to justify than public renewable energy problems, without a clear economic benefit it would be a hard sell for many countries in the region.

In South Africa, the scepticism is accentuated by the country's enormous coal reserves. Cheap coal power is envisioned as a means to improve the country's competitiveness and offset the high costs of labour and transport. Exploration of the immense shale gas reserves and the nuclear option further complicate the picture. Currently, however, there is a serious

lack of infrastructure to support these two energy sources and the projected timeline is medium to long term. Negative public sentiment about the possible environmental impact of fracking could further delay the development of shale gas. Any programme to encourage energy investments in mining would also run into political pressure from labour unions and leftist political parties, who would not support assisting an unpopular, multi-billion dollar mining industry.

## The way forward

Renewable energy holds great potential for mining companies that find themselves in isolated and energy-scarce regions. Renewable energy is cost competitive when compared to diesel generators and some sources are currently competitive against cheap energy sources such as coal in South Africa. The rising costs of traditional energies will certainly drive the transition to alternative energy sources. Additionally, given the long time horizon for 'bridging' fuels such as nuclear or shale gas, it is uncertain whether these technologies will be attractive in the long run.

Private investors – especially foreign investors – have shown strong interest in the renewables sector in South Africa, especially in the newer technologies of solar and wind. This has resulted in $14 billion investment commitments in the country, and companies are looking to springboard into the rest of SADC. In this regional policy context, it is important that there is an enabling environment for renewable energy through a suitable investment climate. Equitable resources should be invested in renewable technologies, and public resources should be directed at the implementation of renewable energy technologies. Suitable fiscal incentives for renewable energy should also be put in place.

To overcome the current uncertainty in the renewables industry, government policies such as feed-in tariffs or net-metering might be useful to overcome up-front capital costs. Removing subsidies for hydrocarbons will further reduce dependence. Building political will on green energy in mining could be particularly challenging, but any government support has the potential to see substantial dividends in increased electrical capacity for the entire region.

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