



# HARVESTING WASTE HEAT

A smelter in Rustenburg has taken the plunge – harvesting relatively low quality thermal energy and converting it to electricity. *David Poggiolini* learns that there are more of these projects in the pipeline.



Having reduced its draw on electrical energy from the national grid, Anglo American Platinum is now moving into its second phase of energy management – a strategy that involves gradually introducing its own electricity generation capacity to its operations.

Gordon Smith, technical executive of Anglo American Platinum, tells *African Energy Journal* that the platinum miner has managed to reduce its energy consumption by between 25% and 30% by drilling down on the efficiency levels of a host of operational aspects of its mines. He says that the outcome of its existing research and development programmes will complement these successes by allowing it to further reduce its reliance on the already-strained South African national grid.

### EARLY DAYS

It is still early days for the research programme and Smith is reluctant to divulge too much about these plans. Yet he says the projects range from harvesting heat to very complex renewable energy projects, including a concentrated solar power plant at its mining operations in Rustenburg, North West province. He says efficiencies of these technologies are the key to their eventual adoption.

A step in this direction is the recent commissioning of its clean energy power plant, Eternity Power Thermal Harvesting, at its Waterval Smelting Complex in Rustenburg.

According to Smith, this plant forms one of the critical components of Anglo American Platinum's electricity generation strategy. This is considering that it exploits the smelter's waste heat, which he believes provides some of the best potential for its co-generation strategies in future.

In fact, Vernon Harding, director of Vuselela Energy, believes at least 50 megawatt (MW) of untapped electricity is available from waste heat in this complex, alone. Vuselela Energy worked with Anglo American Platinum to bring the R150-million plant to fruition and start generating 4,3 megawatts (MW) at the smelting complex. This electricity is being made available to the grid reducing the amount of power Anglo American Platinum buys from Eskom, the state-owned electricity utility. The power generated is also in line with the mining house's strategy to reduce its carbon footprint and promote the more efficient use of energy.

Vuselela Energy will operate and manage the plant on behalf of Anglo American Platinum, under the banner of Eternity Power, a special purpose vehicle that owns the plant.

The plant uses waste heat from the Anglo American Platinum Conversion Plant (ACP) convertor cooling circuit to evaporate an organic liquid and drive an expansion turbine. It has been designed to harvest relatively low quality thermal energy from the smelter and convert it to electricity.

### WORLD FIRST

This technology has been used for heat recovery from other industrial processes worldwide, but has never been used in a smelter anywhere in the world before, with most co-generation initiatives at smelters geared at capturing the combustible furnace off-gas. This is despite smelters emitting large quantities of energy in the form of hot and/or combustible furnace off-gas. The plant at Waterval is a living proof that a waste heat recovery power plant and an industrial process can exist symbiotically.

The basic building block of the plant is the organic rankine cycle (ORC) technology from Ormat Technologies, a major player in the field. The original equipment manufacturer's ORC technology has mainly been used to generate electricity from geothermal heat sources in other parts of the world, but also for waste heat recovery from other manufacturing processes. Ormat has manufactured more than 150 ORC-based power plants in various sizes totalling more than 2 000MW, of which 40 are waste heat power plants almost 200MW. It was chosen for its being able to adjust to highly variable and intermittent heat sources, which is usually the case in smelter environments.

### TECHNICAL FEASIBILITY

Harding says that Vuselela Energy and Environmental Process Solutions had to do a lot of work to integrate the technology into a smelter complex and determine the technical feasibility of the plant. EPS is the designer and engineer, procure, construct and manage contractor on the project. The result is a suite of Thermal Harvesting patents that have been awarded and registered in South Africa.

Harding is extremely optimistic about the potential of the plant, noting that it has the potential to exceed its current output, but a decision was taken from the outset to tread cautiously. This is considering the strategic importance of ACP, which receives the lion's share of the country's platinum output. However, in February 2016, a decision will be made to increase the generation capacity of the plant, based on its performance under extremely controlled conditions.

Reyburn Hendricks, managing director of H1 Holdings, says

the company has a first-mover advantage in a potentially lucrative market. H1 Holdings is the equity provider to Eternity Power. It bought Investec's equity stake in the project. Investec was approached to invest in the initiative in March 2011.

Hendricks says that H1 Holdings' and Vuselela Energy's research has revealed a possible 500MW of untapped electricity in South Africa's smelter environment.

### FEASIBLE AND BANKABLE

At the time of writing, both companies were working on three proposals, which were all feasible and bankable. One of these involves another project with Anglo American Platinum and one with a South African-based cement producer. The latter project, which Hendricks says will call for more "exotic" ideas using the technology, will tap into the abundance of waste heat from a cement maker's kiln firing processes. It is considered a very strategic market for the partners, considering the industry is also under significant pressure worldwide to reduce its carbon footprint.

An obstacle, of course, is the state of smelters, considering the commodities slump. This will have an impact on the bankability of many of these projects. This is where both Harding and Hendricks believe Anglo American Platinum's involvement in the project has

brought significant value.

Vuselela Energy approached Anglo American Platinum with the proposal back in 2010.

Not only did it have significant financial clout to bring to the project, but also the internal technical capabilities needed to investigate very new technology. The pre-feasibility study was completed early in 2011 and feasibility approval was achieved in August 2012. It reached financial close in December 2012.

Another game-changer for Vuselela Energy is its agreement with the platinum producer. Vuselela is looking to make a capital payback after 10 years, and will only start profiting from an electricity purchase agreement it has with Anglo American Platinum. This overcame a big challenge facing independent power producers looking to enter the South African mining industry – mining houses are seldom willing to commit to long-term power purchasing agreements.

### STRATEGIC PLAYER

Another strategic player in helping the technology get off the ground was the Department of Trade and Industry, which provided a R30-million grant as part of its Critical Infrastructure Programme (CIP). The CIP leverages investments to the South African economy by providing infrastructure critical to industrial development with the aim of

increasing exports of value-added commodities and creating employment opportunities.

This was a significant boost for the only co-generation venture in the country that has not been undertaken under the the South African government's very successful Renewable Energy Independent Power Producer Procurement programme. Trade and Industry Minister, Rob Davies, says the project is in line with the government's call for more minerals beneficiation in the country – a strategy that relies on smelters which are also extremely energy intensive. Since 2008, South Africa has been wrestling with limited baseload power capacity. The situation has had a massive impact on key economic sectors, such as mining and manufacturing.

### HIGH PRICES

As Davies also points out, South Africa's electricity prices have increased significantly since 2008. This will also prevent more investment into bolstering smelting capacity. As such, he says South Africa will need more of these solutions in the future.

He is also interested in the carbon reduction benefits of the Eternity Power Thermal Harvesting plant. Davies says that the country is behind the curve in terms of meeting its carbon reduction commitments, and that it will soon have to measure and account for its emissions. ■

## OPINION

Vuselela Energy has reason to be this bullish about its project. It has now proven its technology which will pave the way forward more installations. H1 Holdings sees this as a significant market for the company moving forward, despite its involvement in the very popular Renewable Energy Independent Power Producer Programme. Playing nicely into its hands is dearth of baseload energy in South Africa and a looming carbon tax.

*@D\_Poggiolini*