



## CASE STUDY: SOUTH DEEP MINE

# MINING RENEWABLE ENERGY

Solar energy to help a leading gold mining company enhance energy security and reduce operating costs in South Africa.

Gold Fields, one of the 10 largest gold producers in the world, faces rising energy costs, energy supply constraints, and carbon disclosure requirements. A portfolio-wide energy security review identified its South Deep Gold Mine—which processes approximately 150,000 tons of ore each month, has a peak electricity demand of 60 megawatts (MW), and consumes 500 gigawatt hours (GWh) annually—as a key opportunity to procure clean, cost-effective and reliable energy from renewables. A detailed feasibility assessment and request for proposal (RFP) process led to the development of 40 MW of solar photovoltaics (PV) to help the mine reduce operating expenses, avoid costly production curtailment, and achieve corporate sustainability goals.

## OPPORTUNITY

South Deep is a significant electricity user in South Africa. The local utility, Eskom, generates 95 percent of electricity from coal and has raised power tariffs by an average of over 11 percent since 2014. South Deep participates in an industrial

time-of-use tariff, in which energy prices vary throughout the day based on system demand and the marginal cost of generation. As tariffs increased, energy spend—driven by both usage and peak demand charges—has grown to 13 percent of total operating expenses.

With a planned life of mine exceeding 70 years, these trends presented challenges. The falling costs of solar PV and increasing competitiveness of solar power purchase agreements (PPAs) presents an opportunity to address increased operating expenses, growing energy demand and the need to reduce the carbon footprint.

## SOLUTION

In 2015, Gold Fields engaged with Rocky Mountain Institute's Sunshine for Mines team to undertake a company-wide energy security review and subsequently, to design a renewable energy solution for South Deep. In order to move forward with the project, the solution would need to

be competitive with grid electricity, enhance the reliability of supply, and have a positive benefit-to-cost ratio. South Deep is located in an area with high solar irradiance, so PV integrated with dispatchable storage was selected as the preferred renewable solution. To come up with the system design, RMI and DNV GL teamed up to conduct a detailed site assessment and model a dozen scenarios, taking present and future tariffs, demand curves, and curtailment history into consideration. While the site model results showed that up to 50 MW of PV would be technically feasible, the 20 MW interconnection between the two mine shafts became a constraint that revealed that the optimal solution from both a financial and technical perspective was 40 MW of PV with up to 7.5 MWh of storage. This combination maximized the value from reduced grid energy expenses and avoided production loss while staying under the threshold at which significant investments in grid interconnection or excess storage would be required.

RMI assisted Gold Fields with a two-month vendor selection process, in which Gold Fields sent RFPs to 28 independent power producers (IPPs) and received nine compliant bids—some of which matched current utility prices and others that trended favorably over time. Bids also included storage costs on par with diesel generation, making storage even more attractive. Ultimately, Gold Fields will sign a 20-year PPA for on-site PV generation owned and operated by an IPP at a price favorable to existing utility rates. The teams are aiming to reach financial close in 2017.

## RESULTS

The deployment of the PV systems will enable South Deep to offset 15–20 percent of its energy consumption from Eskom. Gold Fields opted not to install energy storage due to pricing still being prohibitive and being grid-tied to Eskom. The project is forecast to achieve a 114 percent lifetime benefit-to-cost ratio in 2016 net present value, which would increase further if tariff rates grow faster than forecast. The project also bolsters Gold Fields status as a pioneer in developing the gold mine of the future and aligns with a corporate goal of 20 percent renewable energy at all new mine developments, where feasible, over the life of the mine.

## OBSERVATIONS

Gold Fields installed rooftop solar PV at its corporate offices in 2015, which demystified the technology for many executives and helped pave the way for renewable integration at South Deep.

Solar PV at South Deep presents opportunities for participation in South Africa's Black Economic Empowerment program, which further facilitates the mine's social license to operate.



From L-R: Paolo Natali (RMI), Alastaire Dick (RMI), Tsakani Mthombeni, Group Head of Carbon and Energy for Gold Fields, Ned Harvey (RMI), and Thomas Koch Blank (RMI) at the 2016 Energy & Mines World Congress in Toronto, where Gold Fields won the "Renewables in Mining—Visionary of the Year" award.



## About Rocky Mountain Institute

Rocky Mountain Institute (RMI)—an independent nonprofit founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. In 2014, Carbon war Room (CWR) merged with and now operates as part of RMI. RMI has offices in Basalt and Boulder, Colorado; New York City; Washington, D.C.; and Beijing.

## GET INVOLVED

Sunshine for Mines works directly with mining groups at all levels, from the highest strategic planning and monitoring at the corporate level, down to individual projects where technology improvements can be implemented to meet the company's goals. For more information on how your company can benefit from a partnership with Sunshine for Mines, please contact Alastaire Dick: [alastaire@rmi.org](mailto:alastaire@rmi.org).