

Charge and change on the horizon

As one of the largest components of operating and capital costs in the sector, power generation is an important topic. Dan Gleeson finds out there are a growing number of options for mining companies to choose from that are becoming increasingly competitive and reliable

The power dynamic in mining has become increasingly complex in recent years as the cost of renewable electricity has fallen, the capital intensity of battery storage solutions has decreased and the reliability of so-called 'alternative' power has improved.

At the same time, mining companies are trying to wean themselves off coal and diesel power in order to improve their carbon footprints and diversify their energy inputs.

All of this has contributed to rising rates of renewable adoption, with penetration on the up in some of the key mining hubs of Australia, Chile, Canada and West Africa.

Yet, five years ago very few people would believe a mine could consistently be powered by only renewables – capital and operating costs were too high, solar and wind power generation was intermittent, and the business case did not stack up.

There are still some people to be convinced, but Minera Zaldívar believes it will become the first Chilean company to produce copper powered only by renewable sources when its contract with **Colbún SA** becomes effective and power starts flowing in 2020.

This will see some 350,000 t/y of greenhouse gas emissions replaced, equivalent to the amount emitted by close to 87,000 vehicles every year, according to the two companies.

The term 'renewables' has become a catch-all reference, but it is important to understand there are several energy inputs miners can today rely on within this mix.

For example, Zaldívar (50:50 owned by Antofagasta and Barrick Gold) is set to take advantage of hydro, solar and wind power from

existing plants and future projects for its 550 GWh/y power supply.

Then, there are the 'hybrids'. These projects are where most of the renewable power is being generated in the mining sector today; the 'green' energy sources are used alongside diesel, LNG, and heavy fuel oil (HFO) in most instances.

Even when the word 'renewable' is not present in the changing energy mix at a mine, the trend has certainly been towards energy sources generating lower amounts of carbon emissions.

Hannu Jeronen, Senior Manager Industrial, **Wärtsilä Energy Solutions**, said: "There is demand for high efficiency gas, liquid, and multi-fuel plants and customers are increasingly looking to hybridise their plant with energy storage or solar photovoltaic (PV) plant.

Additionally, we have seen increasing interest in alternative fuels such as LNG and LPG due to the uncertainty in the future fuel market."

Paul Marcroft, Vice President of Global Sales for **APR Energy**, told **IM**: "One factor that's becoming regularly prioritised in the mining sector is emissions control, especially in developed markets. Mines are increasingly aware of the role they play in their communities' social responsibility and clean,

ABB previously delivered gas-insulated switchgears, low voltage and medium voltage control centres, medium- and low voltage drives, a distributed control system and a range of automation equipment for KGHM's Sierra Gorda copper operation in Chile. The company also supplied 28 E-houses (one pictured): pre-fabricated, walk-in, modular, outdoor enclosures designed to house a range of electrical and automation equipment

emissions-friendly technology can help them reach their emissions goals."

This diversity of energy supply is likely to continue, according to Tom Miller, CEO of **Cambridge Energy Partners (CEP)**, a company that designs and manufactures re-deployable single-axis solar trackers.

"Moving forward, the energy mix will be made up of a variety of technologies. There is no one technology that is going to win out," he told **IM**.

"It will be a horses-for-courses type of system," he said.

One aspect beyond miners' control that could influence the direction of energy supply is politics.

Chile is seen as a leader in terms of solar power solutions thanks to:

- 1) A ready supply of sun;
- 2) A willingness to go 'green', and;
- 3) Government motivation to move to renewable power.

Fitch Solutions, in a report from August titled, *Shift to renewables to become a global trend in mining*, said: "In light of the Climate Change Pact adopted by 195 countries at the COP21 UN conference in Paris on December 12, 2015, important mining hubs have implemented significant measures to reduce their emissions progressively that have subsequently incentivised mining companies to shift towards renewables."

In Chile and Canada, the introduction of carbon pricing schemes has pushed miners to "increasingly consider ways of limiting their carbon exposure as a core strategic objective



Cambridge Energy Partners' Nomad is a prefabricated and re-deployable solar generator with single-axis tracking technology

Global installed wind and solar capacity by mine

Installed solar PV capacity	Country	Installed capacity (MWp)
Collahuasi	Chile	25
Sandfire Resources	Australia	10.6
Rio Tinto	Australia	6.7
IAMGOLD Corp	Suriname	5
SNIM	Mauritania	3
Okzoyuncu Mining	Turkey	2
Rockwood Lithium	Chile	1.8
Barrick Gold Corp	USA	1.51
Compania Minera Dayton	Chile	1.26
Codelco	Chile	1.11
Cronimet Metals AG	South Africa	1
Shanta Gold	Tanzania	0.63
Galaxy Resources	Australia	0.11
Minera Rafaela	Chile	0.01
Installed wind capacity	Country	Installed capacity (MWp)
Industrias Penoles	Mexico	180
Vale	Brazil	140
Antofagasta Minerals	Chile	115
Grupo Mexico	Mexico	74
Barrick Gold Corp	Chile	22
Rio Tinto	Canada	9.2
Glencore	Canada	6
SNIM	Mauritania	5
Mandalay Resources	Chile	1.8
Nyrstar NV	Chile	1.5
Galaxy Resources	Australia	0.06

Source: Energy and Mines in 'Shift to renewables to become a growing trend in mining', August 31,

Pierre Rivard, Executive Chairman and founder of renewable power solutions company **Tugliq**, said carbon pricing schemes, which vary by province and territory in Canada, have influenced the way miners are thinking about their own long-term power requirements.

"Ultimately it is not so much the current level of tax or price of carbon that matters – it is not currently material enough to be a substantial trigger for energy transition – it is the perspective of the pricing of carbon increasing in a pre-announced way that will prompt mines to mitigate their risk," he told **IM**.

"Diversification is the key here. Carbon pricing is not triggering complete displacement or replacement, but it is triggering a diversification of energy that otherwise would not take place on its own if market forces were left to their own scheme.

This appears to be working – Chile's Association for Renewable Energy predicts 100% of the national grid in the country could be powered by renewables by 2050.

Hybrids on the charge

But there is more to an increasing uptake of these solutions on mine sites than simply energy hedging.

A drop in capital and operating costs, the way vendors are supplying the renewable solutions and an increase in reliability are also factors.



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According to Rob Schueffner, Hybrid Energy Solutions Manager for **Caterpillar Electric Power**, the financial benefits and reliability of renewables available for mines today are quickly matching the environmental benefits.

“The use of renewables with fast-responding generator sets and energy storage already provides the base load in developed and less developed countries alike,” he said.

“As the cost of solar PV and energy storage continues to decrease, we expect to see more and more distributed generation.”

The metric that matters when it comes to cost is the total levelised cost of energy (LCOE), according to CEP’s Miller.

Often taken as a proxy for the average price the generating asset must receive to break even, this is the net present value of the unit-cost of electricity over the lifetime of a generating asset.

Higher operating and capital costs associated with employing renewable technologies in the past meant mining companies required a life of some 15-25 years for the investment to make financial sense.

Now, with the fall in renewable energy tariffs and the advent of more modular solutions, the LCOE equation has changed for the better.

This has led to, in many cases, renewable energy being used as a ‘spinning reserve’ or back-up for grid-power solutions where diesel

power would previously have proliferated.

Some of the companies supplying these renewable hybrid solutions have adapted their business model to win more business from the mining sector, too.

Companies may either provide rented modular renewable energy equipment to clients, or act as independent power producers (IPP) whereby they take on the majority of execution and financing risk associated with employing this power.

Aggreko’s Managing Director, Australia – Pacific, George Whyte feels the company has one up on some of its rivals in terms of the former.

“The use of hybrid solutions at mines looks set to increase, while investment will continue to be driven by innovations in new technology,” he said.

“Our investment in new, efficient and cleaner technology is definitely a differentiator for us, as it shows that we’re adapting our offering to the needs of our customers in this changing energy climate.

“Significantly, offering this as rental underscores the value and appeal of our model.”

According to Tugliq’s Rivard, being an IPP is a key differentiator when it comes to the company winning business.

“A company like Tugliq that finances and takes care competently of all operations and ownership and, essentially, only gets paid if it generates

electricity, makes life simpler for many of the mines,” he said.

Resolute Mining agrees with Rivard’s point of view judging by the recent contract it signed with **Ignite Energy Projects** at the Syama mine in Mali.

Ignite signed a joint development agreement with Resolute for the development of a new 40 MW independent solar-hybrid power plant at Syama.

The plant, to combine solar PV generation, battery and HFO technologies, is expected, when constructed, to be the world’s largest off-grid, fully integrated hybrid power plant for a standalone mining operation.

It will replace the existing historic 28 MW diesel-fired power station at Syama and be facilitated under the IPP model Rivard spoke of.

Not only would it result in Resolute’s power costs coming down by up to 40%, it would see Ignite take responsibility for the design, construction, ownership, funding and operation of the new facility on an exclusive basis with power supplied to Resolute on a guaranteed basis.

John Welborn, Managing Director and CEO, said: “The scale of this project will be a world first – a unique combination of solar, battery, and HFO storage and generation capacity which will provide Syama with long term, low-cost electricity with minimal capital requirements.”

Chris Theron, Managing Director, **CEMS Engineering Consultants**, gave **IM** a rundown of the events that, this year, led to AngloGold Ashanti (AGA) commissioning a hydropower project at its Sadiola gold mine in Senegal using **Gilkes’** Turgo Impulse turbine.

In 2013, Cems Consult assisted AGA in defining opportunities for alternative, green energy with the focus on solar, wind and hydro power. Several scenarios regarding solar were discarded due to the location and maintainability in the remote areas, Theron said.

The opportunity was identified to use hydro power in the main process water line to the mine, according to Theron. Water was being pumped from the Senegal River, some 54 km away, using diesel pumps to an intermediate reservoir from where water was gravity fed to the mine village and subsequent process dams. This provided a head of 120 m and a flow of average 500 m³/hr, he said.

“CEMS Consult had interacted with several hydro companies in preparing a scope and proposal for AGA. Based on the flexibility, track record and being well equipped in Africa, Gilkes were selected and their 12” Turgo proposed for the installation at Sadiola. This would generate around 150 kW at 400 V. A letter of intent was raised in 2015 and orders placed in 2016 for the full turnkey solution,” he said.

“The purpose would be to provide power to the 6.6 kV grid in conjunction with other energy projects. This project would also be used to test the flexibility and efficiency of this system (the future mine expansion would create the potential to look at similar opportunities in the region of 500 kW).”

The proposal was to have a modular design, with the powerhouse, penstock and integration with the AGA facilities designed by CEMS Consult with input from Gilkes.

“The powerhouse was containerised and assembled in total in South Africa at our premises. A Factory Acceptance Test was conducted at Gilkes

prior to final clearance of the powerhouse and infrastructure. This included all structural steel sections, walkways, hoisting equipment and piping,” he said.

“All sections were tagged prior to disassembly and shipped in two containers. This reduced onsite assembly of the works to eight days. The penstock was constructed by AGA as per the submitted design.”

This year all equipment was delivered to site and civil works cleared to start assembly and installation of the powerhouse and turbine. Installation commenced in July, with CEMS Consult managing the installation and assembly of the turbine and associated equipment as well as integration into the existing works.

Commissioning commenced in September, with the unit tested and confirmed to generate 146 kW of power.



The Gilkes 12” Turgo Impulse turbine supplied for AngloGold Ashanti’s Sadiola gold should generate around 150 kW at 400 V

There is a reason such an installation is a world first.

While solar, wind and hydro power are free and abundant, they are not inherently reliable.

As Rivard said in reference to wind power: “Because the wind is fluctuating, you sometimes have extensive power that you cannot absorb on the grid because, if you were to absorb it, you would either have too high of a voltage, or impact the frequency of it.”

This intermittency – also seen in solar and hydro power generation – becomes a problem in any situation where power is relied on for essential services such as ventilation, cooling, or heating.

This is where battery storage solutions and the micro-grids and controllers that tend to come with them are all-important.

Florian Tiffert, Head of Technical Sales in the mining, aluminium and cement division of **ABB**, says the company can design in a number of solutions such as power factor correction, harmonic filters, Static Var Compensators, or energy storage systems to improve power quality and reliability in remote mine sites, with the latter holding much promise, going forward.

“We believe energy storage systems will become more prevalent in the future years,” he said.

Rolls Royce, which has a subsidiary, **MTU Onsite Energy**, focused on diesel generation sets for emergency, base load and peak load applications as well as cogeneration plants, picked up on this micro-grid trend when announcing a recent investment in Berlin-based start-up **Qinous GmbH**.

The company said: “Autonomous electricity networks, or micro-grids, combine cogeneration plants, diesel- and gas-powered generation sets and renewable sources with batteries and a control system that links up all the elements in an intelligent energy management system that optimises the energy usage technically and economically.”

This provides a layer of certainty for companies that are looking to move away from more traditional sources of energy to renewables, with the battery storage systems and micro-grids ensuring that this ‘green’ power is distributed quickly and accurately.

Aggreko acquired Younicos in 2017 to get its hands on such a micro-grid capability and bring together multiple technologies and power sources to support off-grid applications at remote mine sites, Whyte said.

Cat Electric Power’s Master Microgrid Controller (MMC) also has something to add in this regard, according to Schueffner:

“The Cat MMC serves as a major differentiator for Caterpillar, as it leverages the intellectual property we’ve developed for Cat engines and

Back in 2014, Tugliq commissioned a 3 MW Enercon E-82 E4 wind turbine generator at Glencore’s Raglan nickel mine in Nunavik, northern Quebec, hoping to make the most of a plentiful supply of wind energy in the north of Canada.

With energy storage consisting of a flywheel to level-off any speed fluctuations and stabilise the strain and frequency of the autonomous grid, 250 kWh lithium-ion batteries to support the grid, a hydrogen loop comprised of an electrolyser, high pressure storage tanks and fuel cells, a microcontroller and supervisory control and data acquisition for remote monitoring, the project has so far been a success. So much so that Glencore has since installed another 3 MW wind turbine coupled with a bi-directional Li-ion battery system of 3MW / 1 MWh, resulting in renewable energy penetration reaching close to 40% at site.

According to Tugliq’s Rivard, in the 50 months the wind turbines have been operating (to end-October), they have abated 9 million litres of diesel and displaced 26,000 t of CO₂-equivalent.

Average availability over that period has been 97.5%. Considering several Arctic wind power projects had previously failed, this availability level is a significant achievement.

Rivard talked through some of the innovations that helped the company achieve such results.

“The generator is Arctic-rated in that it has some heating capabilities for the blades, which allows it to shed off the ice that forms, maintaining the aerodynamic profile of the blades. This is essential to maintain the rated capacity of the wind turbine,” he said.

A spider-like steel foundation was engineered for the turbine in order to alleviate potential problems associated with melting of ice lenses in Raglan’s permafrost and to reduce the use of concrete by 90% – the latter of which is about four to five times more expensive in the north of Canada than the south, according to Rivard.

Then there is the **Hatch** Microgrid Controller, which monitors demand for wind power and variations of supply, economically dispatching the charge and discharge of the energy storage units.

The algorithms this controller uses are very important, according to Rivard, ensuring mine operations can continue throughout the year.

“We need to have predictive ways to forecast the energy and power available and to meter out the right energy on the grid and in the batteries so we don’t have a shift in the frequency and voltage and can maintain grid stability,” he said.

The company is far from finished when it comes to helping Glencore further improve its carbon footprint.



In the 50 months the wind turbines at Glencore’s Raglan nickel mine have been operating (to end-October), they have abated 9 million litres of diesel and displaced 26,000 t of CO₂-equivalent (photo credit: Justin Bulota 2018 © Copyright TUGLIQ)

“At Raglan, just last week, we commissioned a battery that is going after the second wind turbine we deployed last summer,” he told **IM** in late-November.

“The numbers for the first four years are going to double up on an annual basis due to the second 3 MW wind turbine and a lithium-ion battery with a 3 MW and 1 MWh capacity to sustain a higher penetration of renewable energy on the diesel grid,” he said.

Artificial intelligence is another area Rivard believes will further improve results and lead to Glencore, again, increasing the use of renewable power at the operation.

“The use of machine learning and data mining is going to be very important as we evolve the AI required to make this a more robust way of generating electricity,” he said.

generator sets to optimise system performance and achieve the lowest possible cost of energy. It also provides the scalability that allows our customers to add generator sets, solar PV, energy storage, and weather stations over time.”

And, MTU Onsite Energy has just launched its MTU Onsite Energy EnergyPack, a fully integrated battery energy storage system offering 1 MWh of storage capacity and up to 2 MW of electrical power.

Frank Forberger, Senior Sales Manager, Power Generation, MTU Friedrichshafen, said: “We are going to extend the range of products to an even wider range of EnergyPacks, offering a variety of systems with a broad range of storage capacity and electrical output combinations.

“The recently signed co-operation with Qinous will accelerate the process significantly, and already now provides access to battery storage solutions ranging from 100 kWh up to 1 MWh. Very soon MTU Onsite Energy will be in a position to provide turnkey micro-grids to mine site operators, consisting of MTU’s own products, such as Onsite Energy diesel generators, gas generators, battery storage systems, and a fully integrated energy management system, as well as with PV and/or wind generators of third parties which we will then integrate.”

Staying power

Increasing use of renewable energy may certainly be on the mining landscape, but fossil fuels are still viewed as the status quo in the sectors.”

Tiffert said some mine sites have an installed power base of 200 MW, which still require a connection to high voltage power grids.

“We see renewables power plants of different kinds installed but wind farms or solar power stations, by their nature, are not able to permanently supply their nominal power consistently, making it demanding to operate the grids to the levels that the connected mines rely on.”

Yet, in some locations, the rising cost and volatility of grid power is leading mining companies to look for alternatives.

Fitch said: “Power outages and exorbitant electricity prices are commonplace in key mining markets with immature or inefficient energy sectors.”

And, in even more developed and diversified power markets such as Australia, hikes over the past few years in power prices have impacted margins for miners including Glencore and Rio Tinto, Fitch added.

CEP’s Miller said: “There is some government support for solar in Australia, and it is an interesting place in the respect it is spread out. This means there is a number of opportunities that are away from the grid or on a very costly grid.”

This has seen a broad acceptance of solar power as part of the energy mix in the country.

A number of miners such as Galaxy Resources, Sandfire Resources and Independence Group are either using solar power or looking to use it in the future.

Even when renewables are not selected, off-grid miners are shifting away from diesel use to less polluting options.

There is a clear environmental and cost benefit from switching to LNG from fuel oils, as evidenced by the savings Barrick Gold and Goldcorp projected at its Pueblo Viejo gold mine in the Dominican Republic.

The gold miners, which own the mine in a 60:40 joint venture, earlier this year, signed a 10-year natural gas supply contract with **AES Corp’s** Andres DR SA division to convert the Quisqueya I power generation facility from heavy fuel oil to natural gas.

The use of natural gas is expected to reduce greenhouse gas emissions associated with Pueblo Viejo by approximately 260,000 t/y CO₂-equivalent, Barrick said. The conversion is also expected to reduce the mine’s average cost of sales and all-in sustaining costs by some \$54/oz over the life of the mine.

But there are inhibitors to wider-scale adoption of LNG use, according to APR Energy’s Marcroft.

“Using LNG at a mine site... presents more challenges on the logistics front and, therefore, has registered less demand. Since remote LNG infrastructure does not exist, mines would be forced to transport containers of LNG to a mine site – which is not a feasible solution despite the environmental benefits – unless a reliable natural gas source existed nearby.”

Cost savings have been found when converting to partial solar options.

Zenith Energy recently signed up Independence Group for a hybrid solution at its Nova nickel operation in the Fraser Range of Western Australia. This will see the mine play host to Australia’s first fully-integrated commercial hybrid diesel/solar PV facility, expected to be up and running with a forecast 12.5 GWh/y of solar PV generation in the first quarter of Zenith’s 2020 financial year.

It will see Zenith’s subsidiary, Zenith Pacific, build, own and operate a hybrid diesel/solar PV power station of around 26 MW in installed capacity to “reliably and efficiently service the power needs of the Nova operation”, the company said.

In Africa, there are more and more of these solutions cropping up.

CEP, earlier this year, said Newmont Mining will use its redeployable Nomad solar PV tracker at its Akyem gold mine in Ghana as the US-based company looked to reduce carbon emissions,

energy consumption and costs. According to CEP, up to 60% of the mine’s power was previously sourced from diesel and other fossil fuel generating plants.

CEP’s Nomad is a prefabricated and re-deployable solar generator with single-axis tracking technology.

CEP said Newmont had taken four Nomad units for 120 kW of power, with all of them since installed and commissioned by local staff.

Miller told **IM** that CEP’s modular solar solutions had one or two advantages over a growing number of suppliers in this field.

“We have a very good transport density in our systems; we are able to transport 150 kW per 40 ft (12.1 m) shipping container,” he said.

“We are also able to use bi-facial solar panels and the equipment is able to be delivered to site and installed relatively simply.”

Aggreko has had success at Nevsun Resources’ Bisha copper-zinc mine in Eritrea installing 22 MW of diesel and 7.5 MW of solar-generated power for the company’s copper and zinc operation.

Whyte said: “Owned and operated by Nevsun, this benefits from a 7.5 MW on site solar plant, the first of its kind in the world. Aggreko’s solution has allowed the mine operator to hedge fuel costs and cut around 10,000 tonnes of CO₂ annually.”

Still, in some new off-grid mining operations, project owners prefer the tried and tested diesel route.

APR Energy’s Marcroft said: “Diesel has traditionally been and continues to be an attractive and practical option for the mining sector because of its constant availability and cost-efficiency.”

“In addition, most of the heavy equipment and infrastructure on-site at mines has been designed to function with diesel fuel.”

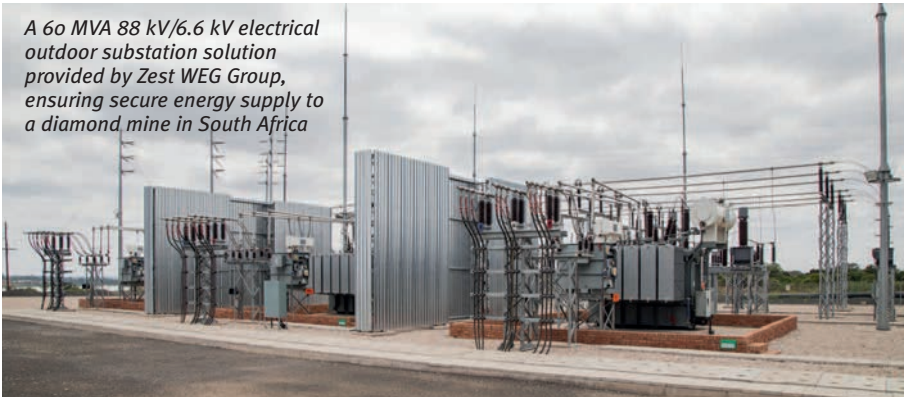
For example, **Zest WEG Group**, a provider of end-to-end energy solutions, was recently successful in securing and completing a large off-grid diesel power project for a junior graphite miner in Mozambique.

Alastair Gerrard, Integrated Solutions Executive at Zest WEG Group, said the company’s Integrated Solutions Division supplied a complete 12.5 MW continuous power diesel generation plant that was designed with the potential to be expanded to 20 MW for future energy requirements.

“Being a graphite mine and considering that graphite dust is highly conductive to electricity, all power plant equipment had to be custom-engineered to minimise the potential ingress of graphite dust,” he told **IM**.

“A complete integrated power plant solution was supplied, including containerised 11 kV generators with air filtration and pressurisation

A 60 MVA 88 kV/6.6 kV electrical outdoor substation solution provided by Zest WEG Group, ensuring secure energy supply to a diamond mine in South Africa



systems, an E-House with electrical MV board and control room, a complete generator synchronisation and plant control system and all plant auxiliary systems including the auxiliary power transformer and plant earthing system, as well as all fuel, oil, air and water systems.”

The generator sets were packaged and assembled by the company's generator manufacturing division, Zest Generator Sets, and most of the power plant electrical equipment was sourced within the Zest WEG Group, he added.

“In addition to the diesel generation plant, we supplied various distribution transformers ranging from 315 kVA to 2,500 kVA and mini-subs ranging from 315 kVA to 500 kVA,” Gerrard said. The transformers and mini-subs were manufactured through transformer manufacturing division WEG Transformers Africa, while Shaw Controls, another division in the group responsible for manufacturing panels, motor control centres, E-Houses and containerised solutions, supplied several power distribution boards to the project. A host of electric motors ranging in size from 1.1 kW to 500 kW were also supplied.

The company's installation and construction business, Enl Electrical, also played a key role in the project, according to Gerrard: “They completed the installation and construction scope as part of the diesel power plant solution and were also awarded the contract to complete the entire electrical and instrumentation installation scope for the processing plant and surface infrastructure.”

The success of the overall project, which came with a value for the group of over ZAR270 million (\$19.7 million), not only involved a tailored approach, but the involvement of many different segments of the group.

Since the project was dependant on a reliable and secure energy source, Gerrard explains that it is essential to work with a supplier that understands power solutions, in whichever form and especially those that require a high degree of customised engineering.

“Almost every project has its own unique set of challenges and constraints. As such, when evaluating and considering the options for a power solution, extensive analysis must be

conducted to clearly understand the needs, unpack all constraints and challenges and select the most appropriate technologies to arrive at a complete and fit-for-purpose solution.”

Cat Electric Power's Schueffner took this further: “It's important to understand that our mining customers have very different needs depending upon where they are in the life cycle of the mine as well as the price cycle for the primary output of the mine.

“Solutions from Caterpillar are attractive because our mining customers can use our modelling tools to develop an optimised energy strategy through a multi-generational plan that changes as the needs of the mine change. This approach allows our mining customers to defer spending on capital until it is warranted.

“For instance, they may choose to deploy generator sets with a small amount of solar when a new mine opens, and then plan to deploy additional solar with some energy storage at a later date.”

This variety of energy solutions really epitomises the state of the mine power sector now.

Whether it is on or off-grid, fixed or mobile, fossil fuel or renewable, power solutions are adapting to the changing state of the industry.

What is becoming apparent, however, is that renewables are increasingly penetrating through the standardised energy mix.

It is no longer a matter of if these solutions proliferate, it is a matter of when.

“Renewable energy is already the least expensive and most feasible option in many areas,” Wärtsilä's Jeronen said.

Aggreko's Whyte said one of the main ways renewables are changing the energy landscape is that baseload is no longer required. The same is true for middle and peak load power, he said.

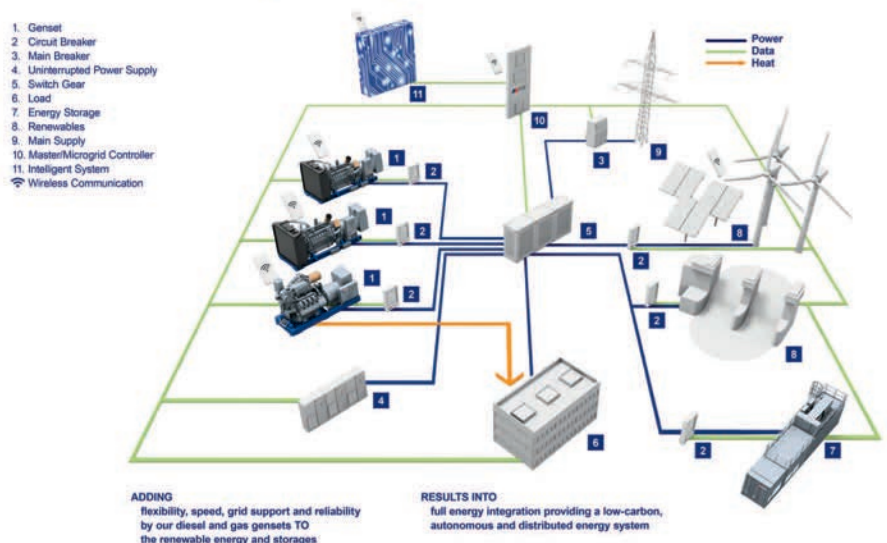
“What is required is flexibility that matches fluctuating production with demand that has always been fluctuating anyway.

“In certain cases with wind and solar, renewables are already beginning to eat into baseload – especially if combined with storage and flexible back-up generation. Add in fuel price uncertainty in rising CO₂ prices, and the economics are starting to work even against written-off coal and nuclear plants.

“In fact, one of the main reasons this isn't happening at a faster rate already is that market design and grids are still tailored towards centralised baseload generation. However, it's clear that customers won't forever be willing to pay huge transmission costs, via grid fees, if they can have a decentralised, cheaper and cleaner energy source closer to the point of demand.

“The bottom line is coal and nuclear will likely go first, while storage and flexible (gas) generation backup the renewables that replace them.” **IM**

The Power under the Hybrid Microgrids



Autonomous electricity networks, or micro-grids, combine co-generation plants, diesel- and gas-powered gensets and renewable sources with batteries and a control system that links up all the elements in an intelligent energy management system to maintain energy availability, MTU Onsite Energy says (source: Rolls-Royce Power Systems)