




**Renewables in Mining:  
Rethink, Reconsider, Replay**

More than just a cost play, renewables offer a distinct competitive advantage

Thought leadership series | Vol. 2



In September 2016, off the back of a major storm, the state of South Australia experienced an extensive blackout in which residential and commercial properties were left without electricity for days.

The financial implications of this blackout were felt strongly by many of the state's miners, including BHP, who lost in excess of US\$100 million in the forced shutdown at their Olympic Dam mine. The long-held assumptions around the reliability of grid-connected electricity over off-grid or 'behind-the-meter' solutions were called into question.

Subsequently, this event provided a catalyst for Australian miners, both those with and without assets in the state of South Australia, to take a hard look at their energy management requirements in the short and long term, and in many cases to rethink the place of renewables going forward.

Realising the full benefits from renewables involves more than installing a solar array or wind turbines, it requires a willingness to rethink operational processes and to reconsider the way work is done.

## Introduction

With renewable energy fast-becoming a mainstream energy source, mining companies have a material opportunity to use renewables to lower costs, improve safety, reliability and sustainability, and mitigate risks to ultimately gain a competitive advantage. Realising the full benefits from renewables involves more than installing a solar array or wind turbines, it requires a willingness to rethink operational processes and to reconsider the way work is done.

The initial article in this series explored how miners can drive value through energy management across the social, environmental and financial triple bottom-line. As a follow-on, this piece takes a deep dive into renewables as a compelling part of the energy management business case.

# The changing landscape of renewables

Energy is one of the biggest expenses for mining companies, constituting approximately 30 percent of total cash operating costs, therefore the rewards of shaving off even a fraction of energy usage can be considerable. Mining companies understand the criticality of energy to enable production and many realise the benefits that come from managing energy efficiently through operational designs that don't rely solely on grid or renewable sources. However, while energy management practices are becoming more prevalent in the sector, some have yet to integrate renewable energy sources and enabling technologies, such as solar and wind power and smart storage, into their energy management programs. This may be due to lagging perceptions about where renewables stand today in terms of complexity, cost, reliability, and performance.

The renewables landscape has evolved dramatically in the past couple of years. Today, major mining companies – ironically, even some of the world's largest suppliers of fossil fuels – seek to use more renewable energy in an effort to drive down costs and curtail emissions<sup>1</sup>. This is due, at least in part, to shifts in the levelised cost of renewable power as compared to traditional fossil fuels, with renewables having already achieved parity in some instances, and fast-approaching it in others. Nevertheless, perceptions about the cost of solar and wind power have largely not kept pace with this new reality, with many miners still thinking of renewables by default as the higher cost option for mines operating both on and off the grid.

## LEVELISED COST OF ELECTRICITY (LCOE)

The levelised cost of electricity is the net cost to install, operate and maintain an electricity system, divided by its expected life-time electricity output. It is commonly measured in \$/MWh.

A recent report by Finkel 2017<sup>2</sup> helps dispel this misperception by detailing the levelised cost of energy (LCOE) for different forms of electricity generation expressed in the average AUD per megawatt hour (MWh):

- > Large scale Solar PV - AU\$91/MWh (US\$69/MWh) in 2020 decreasing to AU\$61/MWh (US\$46/MWh) in 2030
- > Large scale Solar PV with battery storage - AU\$138/MWh (US\$105/MWh) in 2020 decreasing to AU\$87/MWh (US\$66/MWh) in 2030
- > Gas CCGT - AU\$83/MWh (US\$63/MWh) in 2020 increasing to AU\$93/MWh (US\$71/MWh) in 2030
- > Gas OCGT - AU\$123/MWh (US\$93/MWh) in 2020 increasing to AU\$135/MWh (US\$102/MWh) in 2030
- > Wind - AU\$92/MWh (US\$69/MWh) in 2020 decreasing to AU\$79/MWh (US\$60/MWh) in 2030.



## The changing landscape of renewables (Cont.)

Far from slowing, this trend in the declining costs of renewables appears to be gaining momentum globally. The International Renewable Energy Agency (IRENA) projects the cost of electricity from solar and wind power technologies could fall by at least 26% and as much as 59% between 2015 and 2025<sup>3</sup>.

One doesn't have to dig deep to find an example of how renewables can play a role in lowering operating costs. Consider the El Toqui Wind Farm in Chile, now owned by the Australian company, Laguna Gold Limited<sup>4</sup>. Like many mines, the El Toqui operation, which produces zinc, lead, silver, and gold, is isolated from the regional grid system. Due to the high costs associated with operating its five diesel gensets, the previous owner invested in a small wind farm as an additional power source, which was built and commissioned in less than a year<sup>5</sup>.

In 2014, total power generation from diesel, hydraulic and wind farm sources at the mine reached 42.24 GWh at a total cost of US\$6.3M<sup>6</sup>. Of that, the wind farm generated 3.4 GWh of power at an average cost of US\$21.6/MWh, contributing 8.1% of total onsite power generation<sup>7</sup>. This compared to an average cost of US\$254.5/MWh for diesel generation<sup>8</sup>.

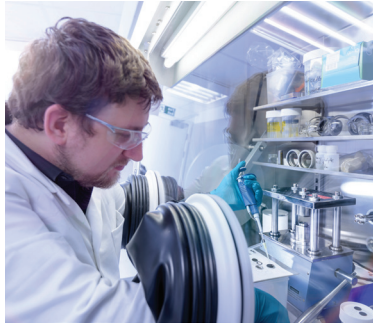
In addition to cost, reliability is another often-cited reason for not considering renewables, but here too these concerns have largely been addressed. When speaking about renewables, there are two facets to reliability. The first relates to the efficacy of the technology itself, while the second relates to intermittency, and the age-old question of, 'What happens when the wind doesn't blow or the sun doesn't shine?'

Again, perceptions around reliability appear to lag the evolution of renewable technology. The viability of combining solar or wind with fossil-fuel power sources has been demonstrated by various prototypes, some of which have proven to be technically reliable even in extreme conditions, such as the Arctic. The Diavik Wind Farm offers a case in point. Located on an island in a remote subarctic lake in Northern Canada, the 9.2 megawatt (MW) farm is the world's most northern large-scale wind-diesel hybrid power system<sup>9</sup>. The project was developed and is owned and operated by Diavik Diamond Mines Inc. (a joint venture between Rio Tinto and Harry Winston Diamond) to help diversify energy supply, reduce fuel costs, curb carbon emissions, and potentially contribute to the company's social license to operate<sup>10</sup>. The latter objective could possibly be achieved by donating the farm to a Northwest Territories community after the

mine closes around 2023<sup>11</sup>. In order to withstand the harsh subarctic climate, the wind turbines have been specially designed and demonstrated to operate in temperatures as low as -40 Celsius, exceeding the industry standard of -30 Celsius and building on Canadian expertise in cold-climate wind technology<sup>12</sup>.

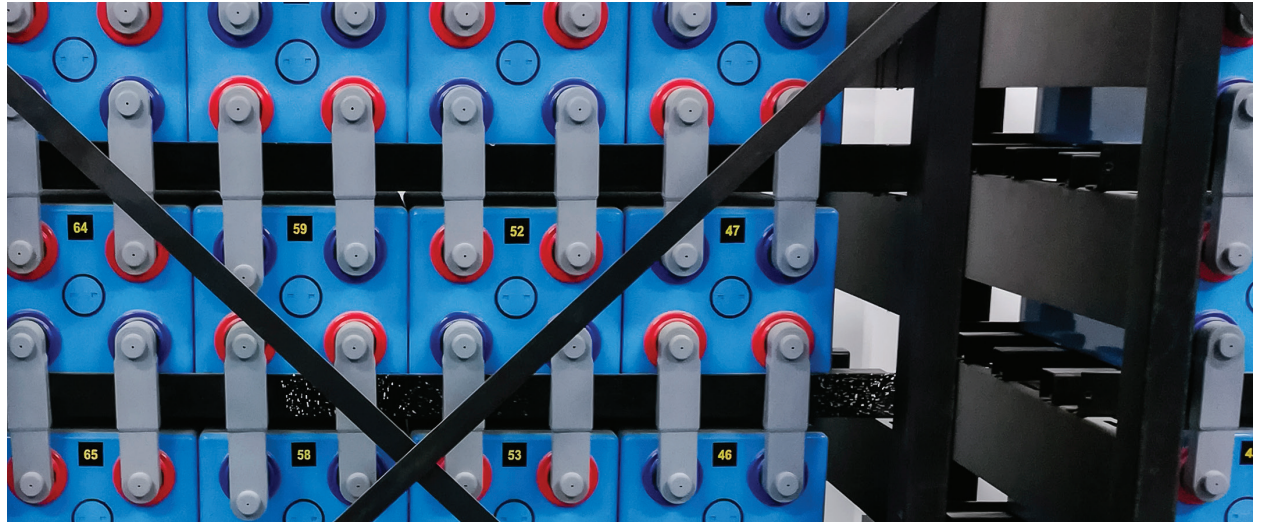
Other developments are also helping to put concerns about technical reliability to rest. Big name players in conventional energy solutions, such as Caterpillar, Cummins, Aggreko, Wärtsilä and ABB are active in hybrid diesel-renewable markets, and their brand reputations are enhancing trust in renewable installations – not to mention that new modeling and simulation capabilities can greatly reduce the risk associated with implementing company-specific solutions<sup>13</sup>.

# An eye on battery



Until recently, the other type of reliability concern, which relates to intermittency, was harder to address. But that too has proven to be more manageable than some anticipated, especially since the viability of battery storage has been demonstrated and the cost of utility-scale batteries is starting to decline. With battery storage becoming an increasingly important, but not the only, part of the equation, mining companies around the world have demonstrated that intermittency can be managed through a range of techniques, including:

- > Co-location of renewables with natural gas or diesel generation – for example, the 115MW El Arrayán wind power plant is the largest wind energy facility in Chile<sup>14</sup>. The project was developed through a joint venture between Pattern Energy and Antofagasta Minerals. Via a power purchase agreement, Minera Los Pelambres, a subsidiary of Antofagasta Minerals and one of the world's biggest copper mines, sources about 20% of its power needs from the plant, which reduces its reliance on diesel generators<sup>15</sup>. Under the arrangement, the remaining power is sold into the Chilean spot market<sup>16</sup>.



- > Tesla, in partnership with the French battery company Neoen, is building the world's largest lithium ion battery in South Australia – a region with significant mining activity – to help the state address energy reliability issues<sup>17</sup>. The PowerPack battery farm will store energy from the third stage of the Hornsdale Wind Farm<sup>18</sup>. When complete, it will top 100 MW of capacity and provide 129 MWh of energy generation to the region for balancing load and supplying emergency back-up power<sup>19</sup>.

- > Shifting high energy-intensity work to coincide with peak solar and wind – for instance, the Cronimet 'Zimb'i' mine in South Africa was facing a scenario where it would have to rely on 1.6 MW of diesel generation capacity to meet its annual power needs<sup>20</sup>. Diesel is often the single largest operating expense for off-grid mines, and unpredictable price spikes can erase profits. To help curb diesel consumption and mitigate fuel-price risks, the company built a 1MW solar photovoltaic plant as part of a solar-diesel hybrid system, which reduced its annual diesel consumption by about 24%<sup>21</sup>. And, to maximize its return on investment, the company shifts its flexible load from peak periods during the evening to the daytime when solar resources are abundant<sup>22</sup>.

# The size of the prize

The companies in these examples appear to understand the size of the prize. Based on our expertise, miners have the opportunity to drive down energy costs by up to 25% in existing operations and 50% in new mines through an effective energy management program, of which renewables are a major component. In addition to cost savings, the ability to reduce emissions and preserve the mine's social license to operate increases the size of the prize even more. In the context of the Paris Agreement, carbon reduction points are a question of how – not if – with renewables positioned to do much of the heavy lifting in the global decarbonisation journey. In unison with the energy sector, mining organisations can play an important and advantageous role in accelerating grid transition around the world, reaping the carbon benefits as they go.

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## Renewables warrant consideration

With the traditional barriers of cost and reliability diminishing, the landscape for renewables has changed enough for solar and wind power, and perhaps even geothermal, biofuels, and other less publicised renewable options, to be considered when evaluating operational strategies, particularly for new mines. Yet, many remain reluctant to consider renewables. This hesitancy is often related to a commodity mindset, where miners want to have a one-to-one substitute for their electricity sources, only cheaper. But, companies that wait for that type of direct comparability forgo any chance of gaining a competitive

advantage and creating shareholder value from renewables. That is because the industry is moving forward at rapid pace. Several large mining companies have been integrating renewables at progressively higher ratios, and all four of the world's biggest miners plan to source more of their energy from renewables, mainly to manage costs, obtain security of supply and to curb emissions intensity<sup>23</sup>. These developments in the mining sector are part of a larger, global trend toward greater procurement of renewables by corporations.

“The clean-energy movement is global, it is industry-agnostic, and it is irreversible.”

**MARLENE MOTYKA**

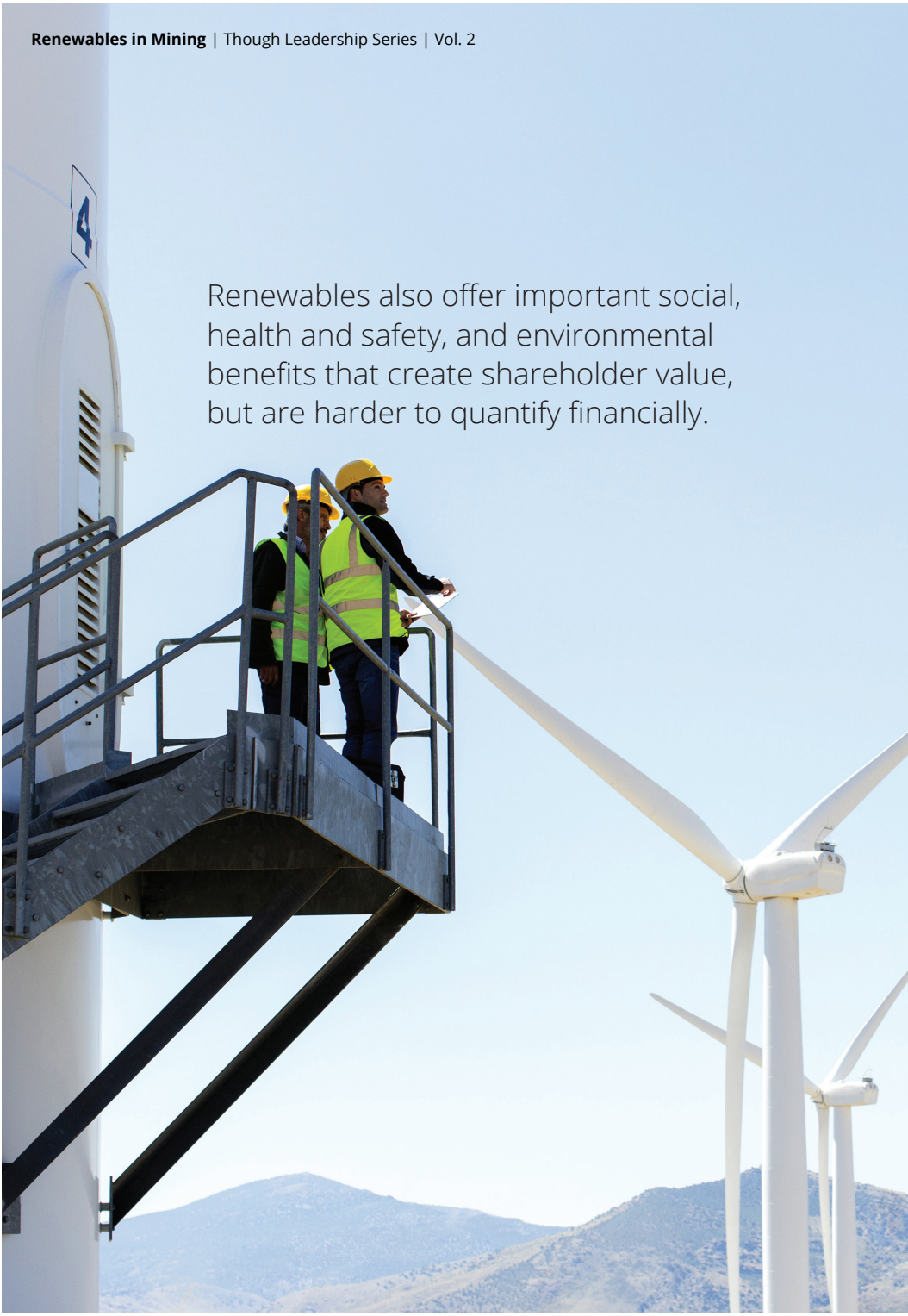
Deloitte Global Renewable Energy Lead Partner

As Marlene Motyka, Deloitte's US and Global Renewable Energy leader, points out, the commercial and industrial segment is spurring development of renewables around the world, even surpassing policy as a driver in some regions. Rapidly falling costs of solar and wind power are one reason for this trend, but the growing number of companies with sustainability goals is also a major factor. In response to increasing corporate demand for clean energy, a host of associations and industry coalitions have sprung up to make it easier for companies to enter into power purchase agreements with developers and utilities or to self-generate their own electricity by implementing on-site solutions. Either way, miners who ignore renewables, do so at their peril. “No matter how

they go about it, companies seeking to address the triple bottom-line of social, environmental and financial value owe it to their stakeholders to consider integrating renewables into their energy management strategies,” said Ms. Motyka. “The clean-energy movement is global, it is industry-agnostic, and it is irreversible,” she added.

Following current trend lines, everyone will eventually incorporate renewables. If miners delay in pursuing this course, they may find themselves on a higher cost curve than their competitors, putting themselves in the unenviable position of being a high cost producer trying to preserve its margins.





Renewables also offer important social, health and safety, and environmental benefits that create shareholder value, but are harder to quantify financially.

## Building the case

The business case for renewables can be complex, which is both a blessing and a curse.

The complexity makes it more difficult for leaders to do their due diligence, but it also suggests that the benefits can be far-reaching. In terms of the war on talent, a focus on renewables is imperative to the attraction and retention of a future workforce firmly focused on the technology and innovation space. Renewables also offer important social, health and safety, and environmental benefits that create shareholder value, but are harder to quantify financially.

While the cost per MWh is still the primary factor, it is only part of the financial equation for renewables, which can potentially include:

- > Hedging against future fuel-price volatility, since solar and wind facilities have a front-loaded cost curve, i.e. high upfront costs to build, but input costs drop to near-zero when operational
- > Lowering operations and maintenance costs
- > Generating revenue from selling excess generation capacity and providing ancillary services, such as synchronised reserve and frequency regulation, to grid operators
- > Shifting work, i.e. synchronising peak load with cheaper renewable energy sources, thus bringing down the overall cost of mining operations
- > Preventing penalties by facilitating compliance
- > Increasing energy security
- > Reducing carbon liabilities by avoiding emissions.

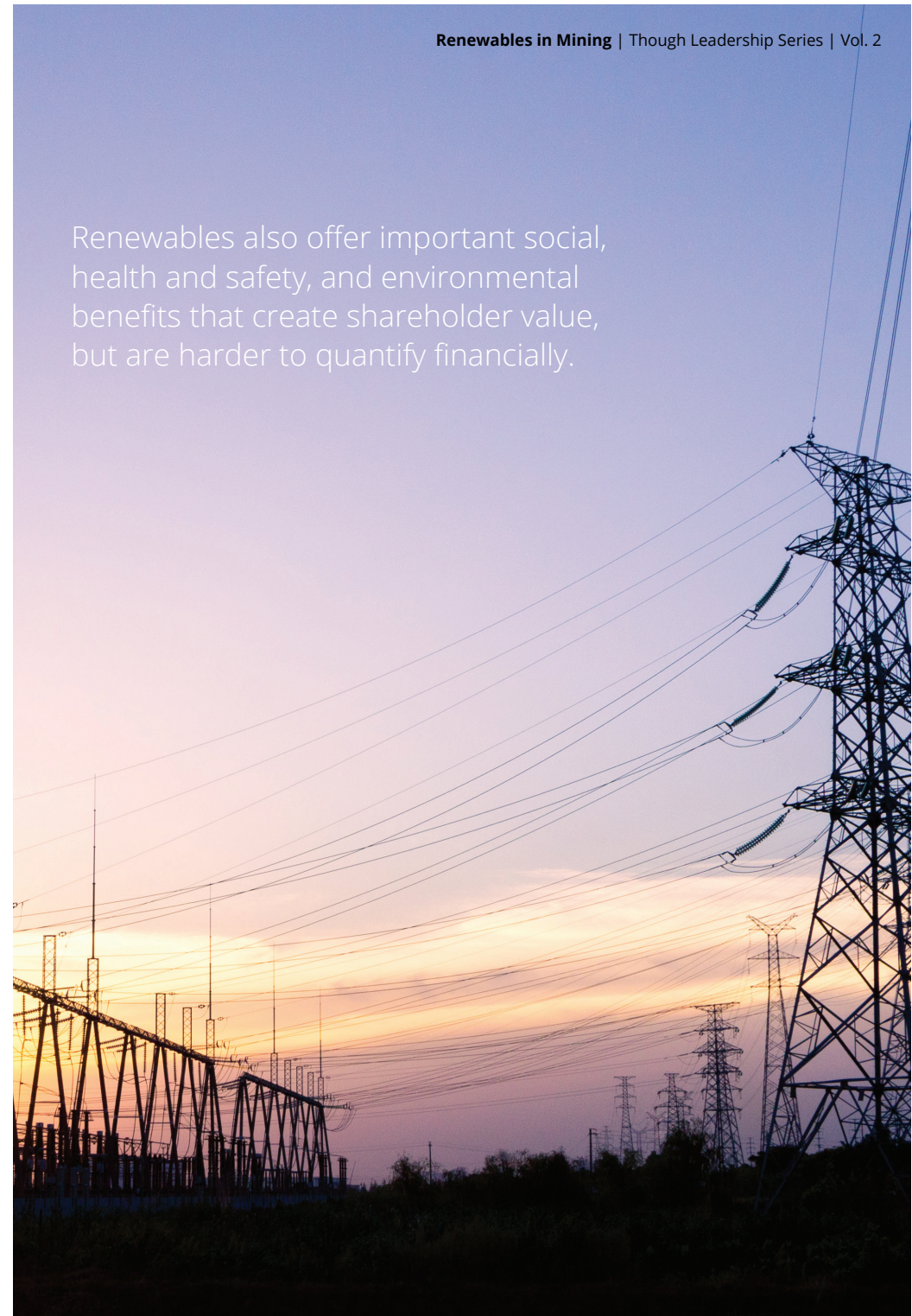
# Digital intelligent grid

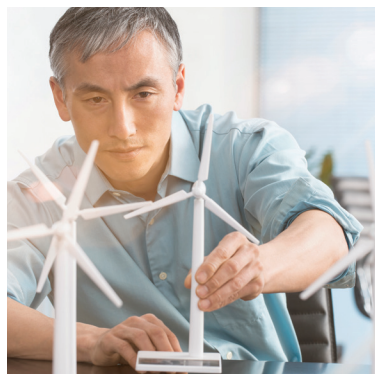
It is important to consider the role of the digital intelligent grid inside the mine environment as well as the load and demand characteristics of the entire mine when configuring the most optimal system, either in off-grid or on-grid conditions. Intelligent controls at the grid edge can enable sophisticated real-time demand management that could go a long way to balance the grid dynamically in response to fluctuating renewable supply. The result is fewer batteries will be needed to guarantee uninterrupted power where it is



critically needed, thus making the business case more compelling. In addition, these intelligent controls are also needed to better synchronise peak shifting and coordinate work storage which further reduce the need for investment in energy storage. High penetration of renewables without solely relying on energy storage to ensure uninterrupted supply of electricity is not possible without the digital intelligent grid. This intelligent grid will eventually incorporate machine learning and artificial intelligence in order to create a dynamical, optimised energy system.

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## Opportunities become clearer

While the business case for renewables is strong, mining companies frequently face organisational and cultural barriers that make it difficult to move ahead. Responsibility for energy procurement and consumption is often fragmented across the organisation, and frequently no individual or group is looking at energy management from a broader integrated perspective. This leads to a lack of awareness of the full range of renewables solutions and value-creation opportunities now available, as well as the inability to articulate and evaluate what needs to be done to take advantage of them. Fortunately, the opportunities for mining companies to integrate renewables into their new or existing practices are becoming clearer.

The unique resource characteristics of a given location, the demand profile of the mine, and the distinct electricity and fossil fuel pricing in a particular region means there is no 'one-size fits all' solution. Nonetheless, finding a solution that works for a particular situation is getting easier. As the data and body of knowledge concerning renewables increases, financing becomes more readily available, and developers offer more flexibility in installation design and configuration. It also helps that certain areas are emerging as solar and wind 'hot spots' for mining, with robust ecosystems forming around them. At present, Africa and Australia lead in developing solar, while Canada and South America lead in developing wind-diesel hybrids<sup>24</sup>.

Much of this activity is concentrated in off-grid mines where diesel fuel is very expensive – a scenario that offers the most obvious opportunity for integrating renewables. But, calculating the return on such projects by simply comparing the levelised cost of renewables with today's fuel price can be deceptive. It can even produce a 'no go' decision because it doesn't consider the full risk/reward ratio and it leaves out some significant value drivers. In building the business case for integrating renewable solutions into mining operations, decision-makers should additionally consider:

- Future fossil-fuel price volatility based on 10-year price forecasts from reputable analysts
- The value of price predictability since renewables provide electricity at a steady price over a set period of time
- The risk profiles of different energy options where the mine is located. i.e. What's the risk of supply disruption? If grid-tied, how frequently do power outages occur? How does this compare to the uptime of the proposed renewable energy solution?

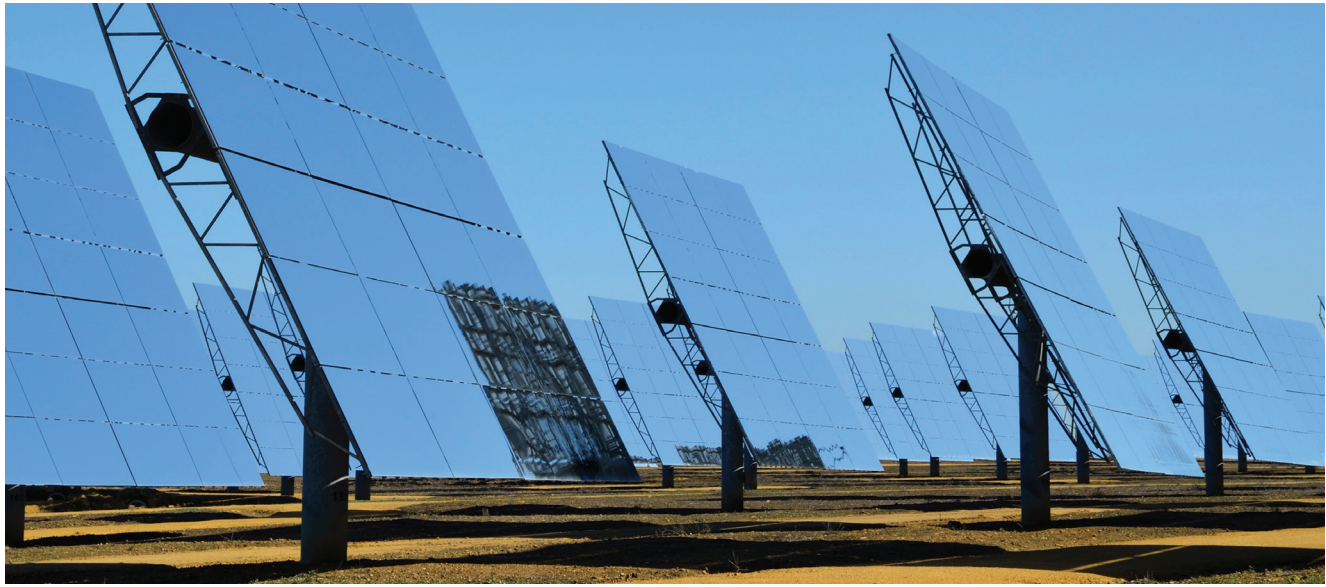
- Availability of funding and tax incentives for renewable projects
- The cost of carbon and savings from emissions avoidance
- Greater insight and control, including the opportunity to shift work to peak power-producing periods, by matching renewables with digital/smart energy management systems
- Post-closure benefits – consider the ROI over the life of the energy systems rather than the life of the mine. Since renewable solutions often outlive the mines themselves, the asset could be given back to the community as an aspect of corporate responsibility; the value of this contribution in terms of brand enhancement and social license to operate (which could facilitate easier permitting and regulatory approvals) should also be factored in
- Greater access to capital – investors are increasingly pressuring miners to demonstrate sustainability and social license to operate. Particularly for mid-caps, adding a renewable component to plans for building a new mine or expanding an existing one could unlock barriers in securing project financing.

# Flexible solutions emerge



Understandably, many mining companies do not want to invest their own capital to cover the large upfront costs or to commit to long-term power purchase agreements (PPAs) that match the physical lifetime of the renewable assets, which can be 20-30 years. Investors, developers, industry associations, and governments are responding to this concern by offering customised financing solutions and shorter-term PPAs. Furthermore, an attractive feature of some of these options is that they allow renewable plants to be financed off the balance sheet.

For example, the Sandfire Resources' DeGrussa copper mine in Western Australia went live in 2016 with the largest solar and battery storage project to date<sup>25</sup>. The \$40 million project was financed by the Clean Energy Finance Corporation and partly through a grant from the Australian Renewable Energy Agency<sup>26</sup>. The French renewable energy firm Neoen owns the solar array and also put equity toward it<sup>27</sup>. The project will allow the mine to run fully on solar power during the daytime if coupled with battery storage.



On the technical side, developers are also offering miners greater flexibility. For instance, some are prototyping mobile renewable solutions that can be dismantled and moved to other sites after the mine closes. For example, the Australian arm of UK-based builder Laing O'Rourke originally developed a modular solar array to cut diesel fuel costs at the company's own remote construction sites<sup>28</sup>. Based on its initial success, the company formed a subsidiary called SunSHIFT to target the large-scale, short-term power market, including mining projects, off-meter applications and remote

communities<sup>29</sup>. The company is in the midst of proving out the concept at scale (1MW) in Australia, with support from the Australian Renewable Energy Association<sup>30</sup>. In many instances, developers are also willing to work with commercial and industrial customers, such as mining companies, to create innovative, customised solutions, like the solar thermal energy system commissioned by Perth-based Agrimin Limited for its potash mining project in Western Australia<sup>31</sup>. The plant will be used to heat water, which is a key part of fertiliser processing<sup>32</sup>.

# How to get started

Here are a few suggestions for how to get in the game – even if your company faces cost or cultural constraints:

- Experiment on a small scale: this is a low-risk, low-cost way to allow people within the company to become familiar with the concept of renewables and to shift into an energy management mindset and away from the common sentiment that miners 'aren't in the business of energy.' A key focus of the trial should consider the capability and integration of the energy system.
- Move beyond seeing renewables as more than a way to solve a supply problem – it's an opportunity to add value to diverse stakeholders, including customers, suppliers, investors and the community.
- While it's practical to start small in the short term, it's prudent to think big in the long run. As a 'stretch exercise', consider where your organisation could go with 100% renewables. Consider the cost savings, health and safety benefits through greater automation, and how it could further your company's sustainability goals.
- Explore the ecosystem around you and the help that's available: government organisations, industry associations, think tanks, developers, operators, investors, and environmental groups are all active in this space. Through this ecosystem, regional data is readily available on solar and wind resources, electricity output, storage, capital costs, operating costs, approval times, etc. Some of these groups also offer financing options.

# Conclusion

Renewables have reached a position where they should be in the consideration set, at least for new mines. But, in analysing energy options, it is short-sighted to evaluate renewables purely as a cost play; instead, they should be examined as part of a broader social and environmental agenda in addition to their financial proposition as a replacement for traditional fuel sources.

To realise the fullness of these opportunities, mining companies will need to challenge their capital projects groups and their design teams to take a hard look at renewable technologies, not just as a pure substitute for existing energy sources, but also as a means of doing things differently. In wading into these waters, mining companies do not have to go it alone.

Renewables developers are seeking industrial customers who can offer utility-scale opportunities, new ecosystems are developing, and business models exist for defraying the upfront costs and sharing the value opportunity.

While it's good to experiment and to perform due diligence, there is a danger in waiting too long. There's an optimal point in any proposed project where a decision needs to be made to integrate renewables, or else the mine life will expire before the full benefits of renewables can be realised. Similarly, on a broader scale, miners must soon decide whether to push forward in the direction of renewables or else they risk becoming the high-cost producers in their respective commodities as renewables increasingly become table stakes for competitiveness.

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# Endnotes

- <sup>1</sup> Barbara Lewis, Miners increase green energy use to power their pits, Reuters, May 16, 2017, <http://www.reuters.com/article/us-miners-climate-change-renewables-idUSKCN18C28B>, accessed August 8, 2017.
- <sup>2</sup> <https://www.environment.gov.au/system/files/resources/1d6b0464-6162-4223-ac08-3395a6b1c7fa/files/electricity-market-review-final-report.pdf>
- <sup>3</sup> Average Costs for Solar and Wind Electricity Could Fall 59% by 2025, IRENA Press Release, June 15, 2016, [http://www.irena.org/News/Description.aspx?NType=A&mnu=cat&PriMenuID=16&CatID=84&News\\_ID=1452](http://www.irena.org/News/Description.aspx?NType=A&mnu=cat&PriMenuID=16&CatID=84&News_ID=1452), accessed August 2, 2017.
- <sup>4</sup> NYRSTAR: Laguna Gold Buys Chile Project for \$25M, Mining Business Media, June 27, 2016, <http://www.miningbusiness.net/content/nyrstar-laguna-gold-buys-chile-project-25m>, accessed August 2, 2017.
- <sup>5</sup> El Toqui Wind Farm, Chile, South America, VERGNET Groupe Website, <http://www.vergnet.com/project/chile-el-toqui/>, accessed August 2, 2017.
- <sup>6</sup> Ibid.
- <sup>7</sup> Ibid.
- <sup>8</sup> Ibid.
- <sup>9</sup> Davik Wind Farm: Wind Energy Helps Reduce Carbon Footprint, Canadian Wind Energy Association (CanWEA), Case Study, <https://canwea.ca/wp-content/uploads/2013/12/canwea-casestudy-DiavikMine-e-web2.pdf>, accessed August 8, 2017.
- <sup>10</sup> Ibid.
- <sup>11</sup> Ibid.
- <sup>12</sup> Ibid.
- <sup>13</sup> THEnergy Analysis: Solar-diesel and Wind-diesel Microgrids for Off-grid Mines Gain Momentum – New Projects Expected, May 15, 2017, <https://www.th-energy.net/2017/05/15/thenergy-analysis-solar-diesel-and-wind-diesel-microgrids-for-off-grid-mines-gain-momentum-new-projects-expected>, accessed August 2, 2017.
- <sup>14</sup> El Arrayan Wind Project, Chile, <http://www.renewable-technology.com/projects/el-arrayan-wind-project/>, accessed August 3, 2017.
- <sup>15</sup> Jan Dodd. Remote Mines Add Wind, WindPower Monthly, January 30, 2015, <http://www.windpowermonthly.com/article/1330527/remote-mines-add-wind>, accessed August 8, 2017.
- <sup>16</sup> Ibid.
- <sup>17</sup> Campbell Simpson, All the details on Tesla's giant Australian battery, GIZMODO AU, July 9, 2017, <https://www.gizmodo.com.au/2017/07/all-the-details-on-teslas-giant-australian-battery/>, accessed September 4, 2017.
- <sup>18</sup> Ibid.
- <sup>19</sup> Ibid.
- <sup>20</sup> Sunshine for Mines: Implementing Renewable Energy for Off-grid Operations, Carbon War Room Research Report – 2014, [http://www.crm-ps.com/upload/files/CWR14\\_MinesReport\\_singles.pdf](http://www.crm-ps.com/upload/files/CWR14_MinesReport_singles.pdf)
- <sup>21</sup> Ibid.
- <sup>22</sup> Solar projects, energy efficiency and load shifting for an optimized energy management in the mining industry, Croniment/THEnergy Study, September 2015, [http://www.crm-ps.com/upload/files/2015SEPT\\_Study\\_EnergyEfficiency.pdf](http://www.crm-ps.com/upload/files/2015SEPT_Study_EnergyEfficiency.pdf)
- <sup>23</sup> Barbara Lewis, Miners increase green energy use to power their pits, Reuters, May 16, 2017, <http://www.reuters.com/article/us-miners-climate-change-renewables-idUSKCN18C28B>, accessed August 8, 2017.
- <sup>24</sup> THEnergy Analysis: Solar-diesel and Wind-diesel Microgrids for Off-grid Mines Gain Momentum—New Projects Expected, May 15, 2017, <https://www.th-energy.net/2017/05/15/thenergy-analysis-solar-diesel-and-wind-diesel-microgrids-for-off-grid-mines-gain-momentum-new-projects-expected>, accessed August 2, 2017.
- <sup>25</sup> Pablo Crespo, Australia's largest offgrid array reaches full operation, Energy and Mines, June 9, 2016, <http://energyandmines.com/2016/06/australias-largest-offgrid-array-reaches-full-operation/>, accessed September 5, 2017.
- <sup>26</sup> Ibid.
- <sup>27</sup> w Finances Major Solar Storage Project at Remote Mine, Clean Energy Finance Corp., July 15, 2015, <http://www.cefc.com.au/media/files/cefc-finances-major-solar-storage-project-at-remote-mine.aspx>, accessed August 7, 2017.
- <sup>28</sup> Sophie Vorrath, Mobile Solar Plants to Challenge Diesel for Use in Mines, Construction Sites, One Step Off the Grid, April 20, 2017, <https://onestepoffthegrid.com.au/mobile-solar-plants-challenge-diesel-use-mines-construction-sites/>, accessed August 7, 2017.
- <sup>29</sup> Ibid.
- <sup>30</sup> Ibid.
- <sup>31</sup> Bridget Fitzgerald. Solar thermal energy to power remote potash mine in western Australia, ABC News, March 29, 2017, <http://www.abc.net.au/news/rural/2017-03-28/agrimin-potash-mine-aims-for-70-per-cent-solar/8391136>, accessed August 7, 2017.
- <sup>32</sup> Ibid.



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