

ENERGY AND MINES

Mining and Energy Big Hitters Discuss Fuel Shifting, Electrification, and Decarbonisation

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“It will take ALL of us taking action to a reduced-carbon future – no single person or company can do it alone – it will really require the entire value chain.”

Q&A Interview with **Denise Johnson**
Group President, **Caterpillar**

In this interview, Caterpillar Group President Denise Johnson outlines the major challenges facing the mining value chain as the industry broadens its priorities to include significant ESG goals.

Energy and Mines: What are some of the most significant changes for the mining industry as a result of the increased focus on ESG and climate performance?

Denise Johnson: The energy transition will fundamentally change the way our customers mine in the future. Their priorities will continue to include safety, lowest cost of ownership and productivity – but now they also have ESG goals to deliver on as well. Miners will now have to consider where to source renewable energy to power the site, how much power they will require to manage the peaks and remain stable, as well as an overall charging and energy management strategy. The combination of key technologies including Automation, Connectivity and Electrification will also be critical to maximize the site outputs. These factors will not only impact the site’s operational performance, but its financial performance as well. To do this effectively, the site will need to run as an entirely integrated system more than ever before. This will require holistic site solutions, which Caterpillar is uniquely positioned to

deliver given the breadth of our portfolio offerings including machines, technologies, and energy solutions.

EandM: What are some of the challenges for mines of trying to balance climate and ESG commitments with mine production, expansion, and commercial realities?

DJ: It is no simple task that miners face to balance their traditional operational goals with new ESG goals. The transition to an electrified mine site will require immense changes to the way these mining companies manage people, processes, infrastructure and technology. The agreements Caterpillar has made with Newmont, NMG, BHP, Rio Tinto, Teck and Vale are designed to make this transition and immense change management effort successful. The initial focus is on the deployment of zero-emissions mining trucks for early testing and validation directly at the customer sites. This program is designed to help these customers learn and prepare as electrified machines and supporting electrical infrastructure and technologies are deployed at their sites, while we are able to accelerate our development. It is win, win.

EandM: Which technologies are expected to be critical in meeting Scope 1 and Scope 2 carbon emissions goals for mining?



DJ: 60-80% of Scope 1 mine site emissions are attributed to diesel powered trucks, as they are the most plentiful mining machine on a mine site. That is why the collaboration agreements we've made with customers are primarily focused on the deployment of battery electric mining trucks – so we can help our customers take the largest bite out of their Scope 1 emissions. Scope 2 emissions are focused on a company's indirect, upstream emissions – such as emissions from the generation of purchased electricity consumed by the company. This is an area that proves it will take ALL of us taking action to a reduced-carbon future – no single person or company can do it alone – it will really require the entire value chain.

EandM: Who are you looking forward to connecting with at the Energy and Mines Toronto Summit on November 1-2 at the Delta Toronto?

DJ: One of my favorite things about the mining industry is how close-knit it is and how you can build long-lasting relationships. I look forward to seeing many of our customers at the event – and meeting those I haven't had the opportunity to engage with yet. Overall, I'm proud to be a part of an event with so many other industry leaders where we can come together over common objectives that will create a better future for generations to come.

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Denise Johnson is speaking about battery electric zero emissions mine trucks and net-zero haulage at the 10th Energy and Mines Toronto Summit, Nov 1-2, 2022

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“It is estimated that 3 billion litres of diesel is imported into the Pilbara in Western Australia each year – to electrify all this energy the equivalent power needed is about 9TWh (more than 50% of WA’s total annual power consumption), which is about 3GW of renewables alone.”

Q&A Interview with **Greg Joiner**
Vice President, Renewables & Energy Solutions, **Shell Australia**

AS CEO of Shell Energy Australia and VP Renewables and Energy Solutions Greg Joiner aims to grow the integrated electricity and gas business by providing more and cleaner energy solutions to commercial and industrial customers. In this interview Greg discusses the huge task facing the energy and mining sectors as they tackle electrification and decarbonisation.

Energy and Mines: How is Shell approaching diesel displacement for the mining sector - what different technologies, fuels and partnerships is Shell developing?

Greg Joiner: At Shell, we work across the entire mining value chain. To meet customers’ short-term needs, we are working with them and partners on technologies and strategies that will have an almost immediate impact on reducing their emissions. These include scaling low-carbon alternatives such as LNG, biogas or biofuels and onsite renewable power for industrial processes. To meet customers’ medium to long-term needs, our focus is on the electrification of fleet and Scope 3 emissions through further cross-industry collaboration.

One project we are actively involved in is the

Charge On Innovation Challenge. Charge On seeks to accelerate the commercialisation of solutions for charging long-haul electric trucks in the mining sector. As one of eight industry innovators who won the challenge, Shell, together with a consortium of partners, is working to develop an end-to-end dynamic electrification solution for mining haul trucks to be piloted at open-pit mine sites.

EandM: What do you see as some of the key considerations for a miner looking to displace diesel from heavy-haulage trucks?

GJ: Through our work with the mining companies, we have identified three core decarbonisation requirements for displacing diesel in mining fleets:

- Decarbonisation without disruption to business operations
- Standardised product to enable customer choice
- Ease of integration with existing platforms

Today, many mining companies may benefit from looking at the fuel they use. Biofuels, for example, have the potential to decrease carbon emissions by more than 70% (see Henry Legge.



“Creating the zero-carbon mine.” McKinsey & Company. June 29, 2021.) and that’s before you consider the operational (e.g. high energy density, drop-in status) or financial (e.g. little infrastructure investment, limited CAPEX investment) benefits too. As an immediate solution to decarbonisation needs, biofuels can certainly help companies bridge the gap between readily available technologies and future breakthroughs.

On the electrification front, Shell’s solution will ensure flexibility in charging options, from how and where charging takes place, to the design functionality that caters for multiple vehicle types. Together with our partners, Shell has invested in a full electrification system that is platform-agnostic, meaning it can be used by various OEMs alongside a site’s existing technology, and can be integrated throughout the entire value chain.

Collaboration and partnership are critical – we can’t do all this alone. Whether that’s

working with electrification partners, Original Equipment Manufacturers (OEMs), or technical service providers, collaboration across all stakeholders and parts of the supply chain will remain a key ingredient for successful decarbonisation. As collaboration helps turn potential into progress, we look forward to continuing our work with our partners to solve these challenges.

EandM: Can you tell us about some of the ways Shell is collaborating with miners directly or mining OEMs on diesel displacement initiatives?

GJ: For example, with the Charge On Innovation Challenge we were able to leverage our global network and experience to form a consortium within weeks, bringing together several technology providers to present an end-to-end solution across the supply chain, from ultra-fast battery storage technology providers to digital fleet management systems.

The involvement of OEMs and mining companies is critical to ensuring the final design is fit-for-purpose, inter-operable and standardised – all key elements to ensure the success of a future scale-up. Of course, the investment or infrastructure needed to make this technology more widely available won’t happen overnight. But with the right level of innovation and collaboration, I’m confident we can lay a strong foundation.

EandM: How do the different technology and fuel options for diesel displacement compare in terms of performance, economics and commercial readiness?

GJ: We believe multiple technological pathways will emerge. At Shell, we approach

trial and test from multiple angles to ensure readiness for the appropriate solution for our customers. For example, for hydrogen technology used in heavy-duty mobility, we are working with truck OEMs to roll out heavy-duty vehicle charging networks across Europe and the US. In doing so, we are learning valuable lessons about refuelling processes that would be applicable to hydrogen mining haul truck applications.

For example:

- In California, Shell has built three new high-capacity refuelling stations for heavy-duty hydrogen fuel-cell trucks in collaboration with Toyota and Kenworth.
- Shell is also a founding member of the H2A consortium alongside Daimler Truck AG, IVECO, OMV and Volvo. The consortium aims to support the deployment of 100's of trucks and more than 20 high-capacity refuelling stations by 2025.

EandM: What do you see as the key challenges for mining companies to completely replace diesel use in material

movement (i.e. heavy trucks and mobile equipment)?

GJ: It is estimated that 3 billion litres of diesel is imported into the Pilbara in Western Australia each year – to electrify all this energy the equivalent power needed is about 9TWh (more than 50% of WA's total annual power consumption), which is about 3GW of renewables alone.

So it is critical renewable energy is available when electrification technologies are rolled out.

For example, the minimum required increase in electrical load for charging these trucks would be in the order of 50MW for each mine. That would require advanced planning and design of the overall mining power infrastructure to ensure safe and efficient delivery of electrification projects.

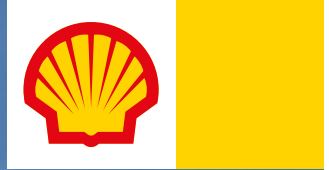
Shell is working with our mining customers to plan for their future energy needs. Developing renewables at this scale will require collaboration and joint investment, as well as planning of firming and storage options to ensure mining operations are not impacted.

LET'S DELIVER NET ZERO TOGETHER

Collaboration is critical for emissions reductions in mining. No one company can reach net zero alone.

Team up with a partner who understands your needs to optimise production while delivering your net-zero ambitions.

Find us at: **Energy and Mines
Australia Summit**
Booth #5



“We consider mines to be a very good application for hydrogen and they can be considered a “Hydrogen Hub” in many respects i.e. requiring hydrogen use and distribution for both mobility, power generation and site operations.”

Q&A Interview with **Jamie Cullen**,
CEO, **Pacific Energy Group**

Pacific Energy has over 600 MW of contracted projects in Australia positioning the company as a market leader by scale in the provision of remote, off-grid energy in Australia. In this interview with Energy and Mines, CEO Jamie Cullen discusses mining remote power, recent acquisitions and the role of hydrogen for net zero mines.

Energy and Mines: Can you tell us about some of the renewable hybrid energy projects Pacific Energy (and its subsidiaries) have moved forward within the last six months?

Jamie Cullen: Yes, there's certainly a lot we're involved with at the moment! We've recently completed construction of an integrated thermal and renewables power station for Horizon Power to supply the town of Esperance, WA. The new station replaced a 20-year-old gas turbine station with 22MW Gas, 9MW Wind, 4MW Solar and 4MW BESS, that we own and operate, making it Australia's largest renewable microgrid town power supply and meeting nearly half of the town's power requirements with renewables.

We are also working with Horizon Power to develop an integrated hybrid thermal

and renewables power station for Denham, WA incorporating a renewable hydrogen demonstration plant. The hydrogen demonstration plant includes a dedicated solar farm for the production of green hydrogen.

We are also at final stages of two hybrid thermal and renewables power system projects in WA which integrate LNG storage & regassification facilities with solar and battery storage. Both projects are a complete inhouse design and turnkey solution that we are providing for Strandline's Coburn Mineral Sands project and Galena's Abra Base Metals project. The 34MW and 18MW projects respectively, will deliver around 30% renewables penetration.

We are also continuing to deliver Stand Alone Power Systems (SPS) via our integrated renewables subsidiary, Hybrid Systems Australia. In Western Australia, more than 52% of the Western Power network, services less than 3% of the users and is expensive to replace and upkeep. We are delighted that Western Power has selected us for each of their 3 rounds of SPS rollouts to date. We design, manufacture, build and install these SPS units to assist with taking customers off the grid as part of Western Power's long-term program. WA is leading the nation in this

Jamie Cullen, CEO Pacific Energy Group



space, although other states on the East Coast are now also looking to introduce SPS's. In addition to this, we are completing one of the largest BESS installations on a mine site with 42MW and have a number of Battery Energy Storage System (BESS) installations underway for Horizon Power in remote regions of Western Australia.

EandM: What is changing in terms of the mining sector's appetite and approach to renewable energy hybrid solutions?

JC: As recent as a few years ago, clients were merely curious and interested about whether renewables could be included in their power solutions. Due to improvements in economics and technology as well as significant global focus on reducing emissions, almost every enquiry we now receive makes a renewables component of the energy solution mandatory. Over 75% of our pipeline now involves hybrid & renewable facilities.

EandM: When do you think we will get to 100% renewable energy, zero-carbon remote power systems for mines? When will this be "business as usual"?

JC: We believe this is still some time away but will be achievable as many of the technologies come together. Renewable energy is intermittent and therefore a reliable base load supply of power is required. As the economics of battery storage improves, this will help to facilitate storage of excess wind & solar.

Pacific Energy believe that green hydrogen will also play a key role in the overall solution, however the economics on both hydrogen and battery storage needs to continue to improve to achieve commercially competitive outcomes.

EandM: Can you tell us about Pacific Energy's recent acquisition of ENGV and your partnership with NEL Hydrogen?

JC: Our recent acquisition of ENGV was an exciting acquisition for the group as it added the final 'Green Hydrogen' piece to complete our renewable energy capability. It has uniquely positioned us to be the only sustainable distributed energy provider in Australia with internal capability to provide and integrate all renewable energy technology and services, including solar, wind, battery, LNG and now hydrogen as well as traditional gas and diesel fired generation.

This puts us in a great position to be able to talk to our mining clients, about introducing hydrogen as a component of their energy generation mix onsite as well as to produce hydrogen for mining fleets. Poising Pacific Energy to help our clients get closer to achieving their net zero carbon goals.

ENGV has had a number of long-standing supply agreements and relationships with leading global suppliers such as Nel, which has now been renewed with Pacific Energy exclusively across the Australian and New Zealand market.

EandM: How does hydrogen compliment Pacific Energy's current offerings for the Australian mining sector? Have you had interest from mining clients in green hydrogen solutions?

JC: Green Hydrogen is a bridge to net zero in challenging environments such as mine sites. With ENGV now part of our group this brings global leading technology and capability to apply and deploy hydrogen solutions throughout Australia. The team at ENGV have



Integrated 34MW hybrid thermal and renewables power station for Strandline's Coburn Mineral Sands Project. Image courtesy Pacific Energy

completed over seven hydrogen installations and will deploy an additional seven over the coming months. These projects range from microgrids, to electrolysis, refuelling, and stationary power via stationary fuel cells. We have been approached by mining clients as well as service businesses that provide goods and services to the mining sector. We consider mines to be a very good application for hydrogen and they can be considered a “Hydrogen Hub” in many respects i.e. requiring hydrogen use and distribution for both mobility, power generation and site operations.

EandM: For mines with shorter lives, i.e. under 10 years, what are some of the ways to build flexibility into energy decarbonisation plans and technological solutions?

JC: We have proven that we can make the economics work for under 10 years. Economics are always improving and so is the

technology, for example on one short term project we are using a re-deployable single axis tracking solar panel solution which is a practical solution to cater for mines with shorter lives.

EandM: What are the next steps for Pacific Energy/ENG V in developing the hydrogen potential for the Australian mining market?

JC: We are developing a unique package of technology which is scalable and transportable for the Australian mining sector in regard to hydrogen deployment. The history, capability and reliability that we have earned over decades of working with our clients in the remote mining sector, together with the market leading hydrogen knowledge and experience that ENG V brings to table, will enable us to understand the client's needs and the operating environment to deliver reliable renewable hydrogen solutions.

“A genuine paradigm shift is taking place. On the one hand, there is the replacement of fossil fuels with renewables. On the other, we have the development of new technologies such as energy storage and hydrogen, the electrification of certain sectors, and digitalization”

Q&A Interview with **Werther Esposito**
Country Manager, **Enel Green Power Australia**

As Country Manager with Enel Green Power Australia, Werther Esposito's 12+ years of experience allows him to have a deep cross-functional knowledge of the energy market. In this interview Werther discusses how Enel Green Power is positioned to help the mining sector globally in the shift to carbon free and net zero.

Energy and Mines: How is the drive to decarbonisation shifting the thinking and approach to renewable energy for mines?

Werther Esposito: The mining industry is facing the challenge and opportunity of decarbonising their commodities to market. This challenge and opportunity directly impacts the commercialisation of mineral extraction throughout Australia and globally.

How can the mining industry provide the essential resources required for today's economy whilst reducing their environmental impacts. The dual mandate of Business as Usual (BAU) and profitability coupled with Environmental Social Governance (ESG) considerations has become a primary focus for miners in Australia and internationally. A key

component in answering this question is the incorporation of renewable energy into the BAU of the mining industry.

In addition to renewable energy, mines can implement site specific operational efficiency and embark on electrification of existing processes. These additional activities have varying risks and returns while renewable energy is a proven pathway to cost effectively reducing carbon emissions in all mining operations.

With decarbonisation of mining operations as the clear next step in business models, contracting electricity from renewable energy projects can cost-effectively achieve this end and provide the means for a mining company to differentiate themselves with their customers and their communities.

EandM: Enel Green Power recently signed a 12-year Power Purchase Agreement (PPA) with BHP for the supply of 100% of the output of Flat Rocks Wind Farm. Can you tell us more about this project?

WE: Flat Rocks Wind Farm Stage One project has an investment value of over \$200 million and will consist of eighteen

4.2 megawatt (MW) Vestas wind turbines and the related civil and electrical infrastructure.

The wind farm project site spans the shires of Kojonup and Broomehill-Tambellup, in the Great Southern Region of Western Australia and will bring approximately 120 construction jobs to the area during construction peaks. The project is currently in pre-construction planning phase and due for full operation in early 2024.

Enel Green Power (EGP) has entered an important partnership with BHP to supply ~315 Gigawatt Hours (GWh) of renewable energy comprised of electricity and corresponding Large-Scale Generation Certificates (LGCs) for 12 years.

As BHP is one of the world's leading mining companies, with a target to achieve net zero operational emissions by 2050 and has intermediary targets for 2030, this commitment to renewable energy highlights its progress towards achieving these targets.

EandM: What are the next steps for the wind farm and what are some of your initial takeaways from this partnership with a mining company?

WE: Partnerships like the EGP/BHP partnership are an opportunity for Enel Green Power to continue to expand its understanding of the complexities of the



mining industry and continually develop products and services to meet the needs of different mining companies globally. EGP operates in over 30 countries and has a strong presence in minerals-rich countries including Australia, Chile, Peru, and Brazil, so naturally, we are interested to continue to expand in this sector.

Enel Green Power are committed to building strong partnerships with the mining industry across the world. For example, through Enel's subsidiary Endesa X, we are building a behind the meter photovoltaic plant for a mining project in Spain. In Chile, through Enel X Way, we are providing the AngloAmerican copper mine with e-buses and electric stations to replace their traditional buses. We are also using wind-generated energy in the Magallanes region to obtain low-cost hydrogen through water electrolysis.

Many mining companies are committed to being sustainable producers and have developed ambitious decarbonisation targets. Working together with companies to achieve their carbon reduction and sustainability targets, can enable cost-positive abatement approaches and make concrete steps towards accelerating the energy transition.

EandM: Do you see opportunities for additional PPAs and off-grid hybrid

projects with Australian mines for large-scale renewable energy projects?

WE: There is significant potential for additional growth in corporate Power Purchase Agreements (PPAs) within the mining industry, both with mines that are grid connected and mines that are isolated from the grid.

Off grid power solutions, either stand alone or a hybrid power solution (renewable energy projects and Battery Energy Storage Systems) can drive down operational costs and fulfill Environmental Social Governance (ESG) requirements and targets across all types of mines. Off grid power solutions can also eliminate the risk of intermittent generation and power interruptions if they are designed to do so.

Some of the benefits of a PPA can include energy cost certainty, protection against price volatility, lower operational costs and can reduce overall energy management complexity.

EandM: What products and services are you focusing on to support mining's sustainability and energy transition targets?

WE: Enel Green Power solutions can be tailored to effectively meet the energy requirements of our mining customers whether grid connected or off grid. We can supply green energy produced from renewable sources, via the grid and can also service mines in off grid areas. We have global experience in local mini-grids powered by wind, solar, geothermal, or mini-hydroelectric plants, supported by storage capability (geography dependant).



Electrification of site operations and the introduction of green hydrogen into operations can further enhance a mines operations and profitability. Electrification can be used throughout the whole mining supply chain to reduce emissions in different applications such as replacement of diesel in trucking. Green hydrogen produced from water electrolysis powered by 100% renewable energy is the only sustainable and emission-free hydrogen. It is as a reducing agent in the smelting process and a fuel (in form of Ammonia or e-fuel).

Image: Stock Photo



Enel Green Power is committed to a Creating Shared Value (CSV) approach focused on working in partnership with key stakeholders to deliver sustainable energy across all projects. This approach means Enel Green Power commits to enhancing the economic and social conditions in the local areas to all its projects and proactively share benefits within each local community. The overall objective is for each project to be considered as an integrated and valued component of the social and economic fabric of the local community.

Enel Green Power is a solution integrator, capable of offering a unique platform to integrate products and services together with a green commodity and beyond commodity solutions catalogue. The company's modular approach consists of a broad range of Net-Zero services (covering Scope 1, 2 and 3), from data gathering, greenhouse gas (GHG) emissions calculation, tracking and reporting to carbon roadmap definition, and related implementation, as well as renewable energy supply and on-site energy efficiency solutions.

EandM: What key market developments would support and further facilitate renewables for grid-tied mines?

WE: A genuine paradigm shift is taking place. On the one hand, there is the replacement of fossil fuels with renewables. On the other, we have the development of new technologies such as energy storage and hydrogen, the electrification of certain sectors, and digitalization. The latter is accelerating the energy transition through the deployment of cost effective and sustainable energy generation.

Implementing solutions related to the grid connection process and technical requirements, and additional investment in grid infrastructure, will continue to support new renewable generation, facilitate the construction of new renewable energy projects and could facilitate further renewables for grid-tied mines.

Deploying battery energy storage systems in mining

Juergen Zimmermann heads Business Development and Technology for Hitachi Energy's Grid Edge and Microgrid Solutions business in Australia and New Zealand and has been involved in the development and construction of microgrids for over 30 years. He is responsible for developing new projects and innovative solutions for off-grid and grid edge microgrids as well as deployment of Virtual Synchronous Machines in combination with battery energy storage, to stabilise large power systems.

Juergen's project experience includes the first large scale grid forming battery system at Dalrymple in South Australia, as well as the Alinta Newman Battery in Western Australia and Woodside's offshore Goodwyn battery energy storage system (BESS), all using Virtual Synchronous Machine technology.

In this interview with Energy and Mines, Juergen discusses how energy storage applications in mining are essential as mines seek to integrate a higher amount of renewable energy to achieve their carbon emission reduction targets.

Energy and Mines: What feedback and interest have you had recently from mining companies on the potential role of BESS as part of decarbonising mine power systems?

Juergen Zimmermann: It is our experience in microgrids that shapes our vision of the future grid system, one that is modular, decentralised and smaller, especially in emerging areas like mining operations. We are witnessing a rapid evolution in infrastructure due to demand for more electrification.

Power systems in mining and other industries are seeing a major structural transformation as renewables and energy storage costs continue to decline and global pressure to mitigate CO₂ emissions remains strong. For off-grid mining, renewable energy and storage technologies present an ideal opportunity not only to improve the mine's environmental footprint, but also reduce energy costs while improving power quality.

We are seeing a strong drive to optimise energy across mines, including solutions for e-mobility and rapid charging.

EandM: Is energy storage becoming business as usual when mines assess the feasibility of hybrid energy solutions and, if so, what is the main driver for this?

JZ: Incremental hybridisation for lower carbon and a lower energy cost future with renewables and energy storage, is the goal for many mining operations.



The mining industry is energy-intensive with power consumption accounting for 15% to 40% of a mine's total operating budget. Most mines, especially those located in remote off-grid regions, rely heavily on diesel or gas generators for power. Mines are also under severe scrutiny to follow local and international environmental regulations while working towards achieving net zero emissions from their operations.

The incorporation of electric-powered haul trucks is a huge opportunity for the mining industry. Designing a solution that can integrate battery-powered equipment with existing mining processes – without disrupting current (non-stop) operations, will be critical to achieving emission reduction targets.

EandM: What are some of the key considerations for a mine when assessing energy storage options?

JZ: In the past, the key energy consideration for mining focused on ensuring the power was “always on” to maintain productivity. This has changed recently with the introduction of renewable energy options and pressures to reduce CO₂ emissions. Today the key is finding the right balance between the two.

To help future-proof against rising fuel costs, mines are now adding renewable energy sources and storage technologies to run mining operations, while improving power quality efficiently and safely. These include:

- Adding BESS to improve overall generator operational efficiency and reduce maintenance costs.
- Adding BESS to off-grid mine sites for virtual spinning reserve, which has one of the most compelling businesses cases for storage and paybacks typically under 5 years.
- Locally installed solar power plants which deliver the largest reduction in fuel consumption and levelised cost of energy (LCOE), while maintaining a healthy internal rate of return. Some mine operators are already using their own land adjacent to mines

to generate solar energy that is then used to power mine operations. These mine-owned projects can then be scaled up and tied to the grid to sell excess power back to local communities.

- Solar and wind energy in combination with BESS are clear pathways for the energy transition in mining, while meeting energy production needs for long-term growth. The right integration of these different components is key to success.

EandM: What lessons have been learned from operational storage projects for mines?

JZ: Hitachi Energy helps customers utilise BESS to address several challenges converging at once by:

1. Minimising OPEX significantly through reduced use of fossil fuels, such as diesel and gas
2. Ensuring high power quality to supply off-grid mines with renewables
3. Ensuring continuous mine operations and maximising productivity
4. Minimising dependency on grid power supply
5. Complying with environmental regulations
6. Becoming energy self-sufficient.

Overall, mining companies can start transforming their mines today as renewables, specifically solar PV, can now deliver a lower LCOE than diesel. Deployment of solar PV with BESS, for example, is an excellent hedging solution against diesel or gas price



increases and/or future carbon costs.

EandM: Can you share any new projects you are working on with mining clients on storage integration?

JZ: Sandfire's DeGrussa's Mine in Western Australia. Built in 2016, the hybrid solar, diesel and energy storage system has reduced Sandfire's CO₂ emissions by 30,789 tons and offset 11 million litres of diesel. In addition to the environmental benefits, the project has provided a blueprint for the adoption of renewable energy at mine sites and remote communities around the world, and has been widely showcased as a success story on how to integrate renewables at mines.

Alinta Energy is supplying Roy Hill remote mine at Newman in Western Australia. This



is one of the largest microgrid installations in the world and has been operating since 2018. Alinta Energy needed a reliable and stable power supply to reduce interruptions, emissions, and fuel costs at the Roy Hill mine site. Hitachi Energy's energy storage and automation solution delivers a reliable and stable power supply that ensures continuous operation and increased energy efficiency. This system had a payback of less than 5 years for the operator.

Fortescue Metals Group (FMG) is part of a group building Western Australia's largest network-integrated BESS, featuring Hitachi Energy's PowerStore™. This is an example of FMG's larger goal of achieving carbon neutrality by 2030.

The Indo Tambangraya Megah (ITM)'s Bontang

Mine in Indonesia relied entirely on fossil fuels for their operations. Now, the mine has the largest microgrid in the region with the integration of solar PV and PowerStore™ BESS, dramatically reducing fuel consumption and CO2 emissions. The new technology enables the mine to maximise the use of renewable energy, driving energy efficiency, sustainable growth, and improved reliability.

EandM: What are the latest developments in battery energy storage costs and technologies for mining applications?

JZ: Advanced (grid forming) inverters are a key transformative technology for power systems around the world, providing the most effective performance today and future proofing the power system for high levels of renewable energy penetration in the future. While advanced inverter technology has gained significant interest over the past 18-24 months, Hitachi Energy has been delivering this technology for more than a decade, including at many mine sites.

Hitachi Energy has a long history with more than 250 years of combined heritage providing energy solutions to mining operations, utilities, and remote communities — anywhere people want clean, low-cost, reliable and stable energy. More recently, Hitachi Energy has evolved to focus on energy solutions that support and enable the clean energy transition.

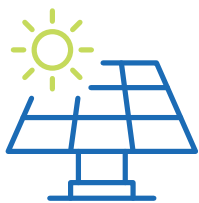
Mining companies have a great opportunity ahead to take advantage of new technologies and techniques that can help them achieve their sustainability goals, while continuing to deliver strong financial performance.



Our experience: Energy Solutions for the Australian Mining Industry since 2014

Our passion:

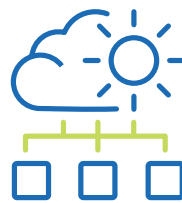
Wind, Solar and Energy Storage for over 25 years



1,850 solar plants
3,250 MW, worldwide



1,200 wind energy plants
2,800 MW, worldwide



Storage and
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