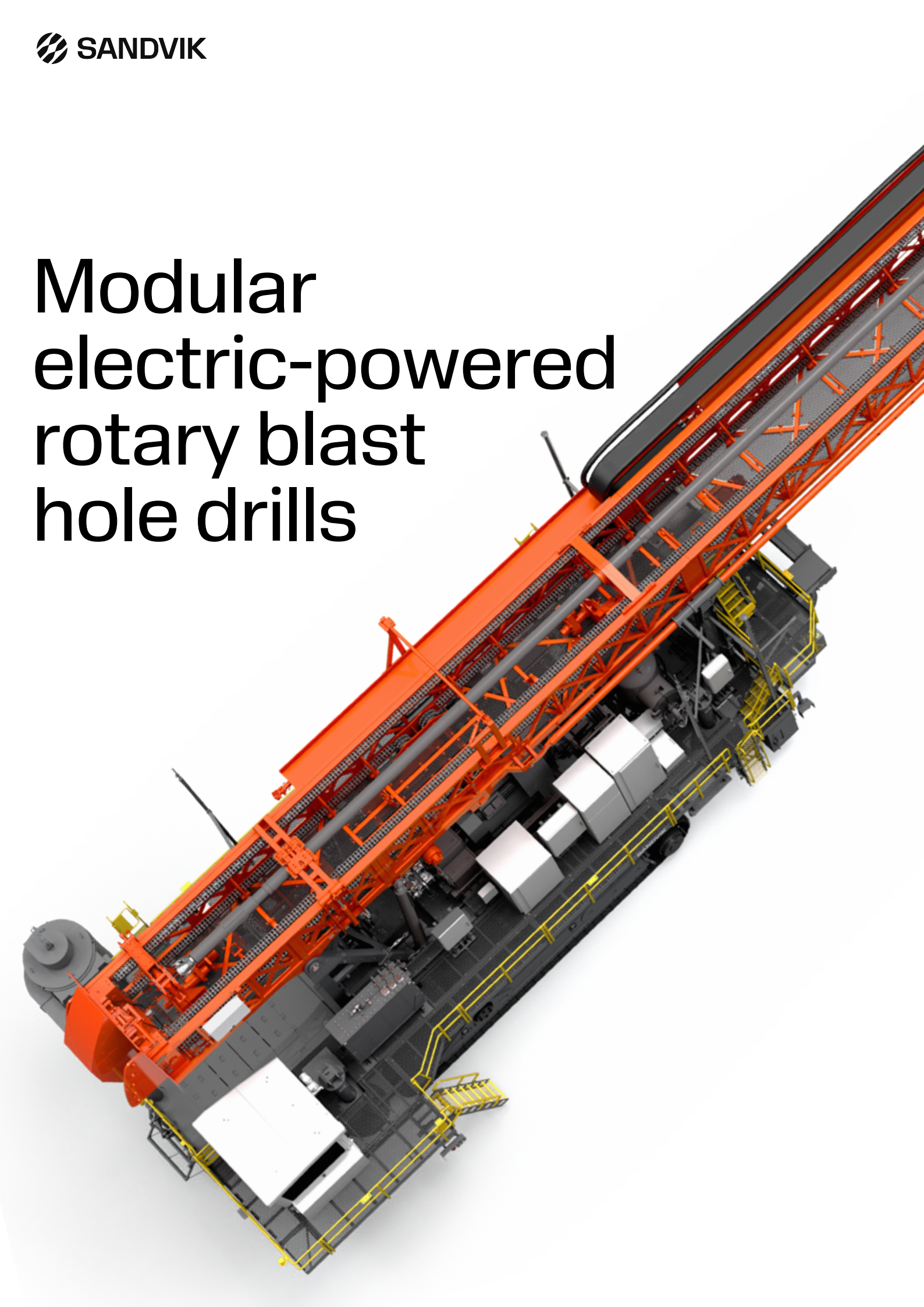
SANDVIK

Modular electric-powered rotary blast hole drills



Sustainable mining: how modular electric-powered blast hole drills are transforming the industry

New modular designs make it easier for mining companies to transition from diesel-powered to electric-powered rotary blast hole drills, helping the mining industry shift to a more sustainable future.

Up to 5,200 large rotary blast drill rigs are in operation around the world today and annual sales are around 400 per year, according to Sandvik Mining and Rock Solutions, a global supplier of equipment and tools. Already around 30-35% of the new drills sold are electric-powered, a proportion experts believe could increase to 50% in the near future.

The global mining industry is responsible for up to 7% of greenhouse gas emissions, according to McKinsey & Co, a consulting company. Many industry stakeholders are now eager to reduce emissions. One of the main ways they can achieve this is by transitioning from diesel-powered to electric-powered rotary blast hole drills. This shift supports a circular economy — minimising waste and maximising resource reuse — while reducing reliance on fossil fuels, cutting emissions and helping mining companies meet global sustainability standards.

“Mining — like all industries — is constantly evolving with the latest technological advancements aimed at achieving zero emissions,” says Nellaiappan Subbiah, product manager, rotary drills at Sandvik Mining and Rock Solutions. Processes that have been well-grooved by decades of activity need to be re-engineered as mandates and ethics demand investments in sustainability and carbon emissions reductions. That demand doesn’t brook negotiation. Without adherence to prevailing regulations, miners will lose their licences and permissions to operate. So, whether they go into this willingly or unwillingly, miners must change.

“That need to change is seeing progressive miners of all sizes and specialisations make investments in automation, digitalisation, data analytics and anything else that can aid their cause. But where the rubber hits the road — or rather where the drill meets the ground — is the place to start. In drilling, we see the advent of a massive transition from diesel to electric.”

Reduced total cost of ownership

Furthermore, Subbiah says electric-powered drills should significantly reduce the total cost of ownership (TCO) compared with diesel-powered drills. TCO refers to the cost of purchasing, operating and maintaining equipment over its lifetime, including energy, maintenance and replacement expenses.

Electric-powered drills offer advantages such as lower maintenance requirements, extended component lifespans, quieter operations, and reduced energy demands.

Switching to electric power removes several standard diesel components — such as filters, cooling packages, exhaust systems and fuel tanks — all of which involve considerable maintenance. This results in a prolonged lifespan for drilling equipment. Moreover, while a diesel engine converts only about 30-35% of chemical energy into mechanical energy, a high-voltage electric motor achieves an efficiency of 90-95%.

Lifespan of a blast hole drill rig in years

15 to 20

Avergage life estimate of a diesel engine

20,000 hours

Avergage life estimate of an electric motor

60,000 hours

The lifespan advantage of electric over diesel is significant. A diesel engine typically lasts about 20,000 hours, whereas an equivalent horsepower electric motor can last between 60,000 hours. This long lifespan means that a company may not need to replace the prime mover for the whole of its life, a crucial advantage in harsh, remote locations characterised by extreme weather, limited accessibility or high altitudes.

“A rotary blast hole drill rig can have a lifespan of 15 to 20 years,” adds Subbiah. “Assuming that a mining site has 20 drill rigs and five draglines, you can imagine the environmental impact of all those machines, with the carbon emissions and other associated factors.”

“This is why many big mining houses are moving towards electric-operated equipment, not just the drill rigs but the shovels, draglines, trucks, and everything. They are shifting towards electric because they can become a green solution provider rather than be seen as a polluter of the natural environment. We can help with the first part of the transition process — shifting from a diesel-powered to an electric-powered drill rig.”

Electric-powered drills have tax advantages

Furthermore, the global mining industry is under increasing pressure to reduce emissions and comply with rigorous environmental regulations. In many countries, adopting sustainable solutions — such as electric-powered drill rigs — offers significant tax benefits.

Companies that switch to electric power — thereby reducing CO_2 emissions — often benefit from receiving electricity at a subsidised rate compared with diesel fuel. This makes the shift more cost-effective.

Moreover, substantial financial incentives exist for companies transitioning to electric-powered drill rigs, particularly in developed nations. Many countries provide tax benefits, for example.

An additional advantage of switching to electric power is that the motor control cabinet or transformer does not need a lot of maintenance compared with the complexity of a diesel engine with its exhaust system, fuel system, radiator, charger cooler, and air-intake filters. These parts usually have high levels of wear and tear and must be maintained by regular interventions every 500 to 1,000 hours. With an electric-powered machine, these interventions mostly disappear, resulting in a total maintenance time saving of about 68% compared with diesel, according to Sandvik Mining and Rock Solutions.

In addition, there is a widespread movement within the industry towards optimising energy usage across various operations, including tramming, levelling, drilling, and pipe handling. By making these processes energy efficient, the overall power requirements for mining equipment can be substantially reduced. The focus is on refining every operational aspect to achieve maximum energy efficiency, decreasing power consumption markedly.

> “Our machines draw electrical power from the grid via the substation to perform all functions. Typically, there is a blast every day or every other day, so the machines must be cleared for these events. The main challenge lies in moving the electric drill and managing the cables, which is more difficult than working with diesel-powered drill rigs.”

Safety is paramount

Safety is another advantage of going electric. Sensors can more easily be deployed to monitor various operations such as the speed and direction of the rotation of cable reels and the force on the cable. An operator no longer needs to leave their cabin and take remedial actions, and information can be relayed to a remote control room.

More broadly, automation can also be tapped to minimise manual human interventions and lower cycle times between operations. Automation can also maintain minimum distances between cable routings to avoid electromagnetic interference.

Furthermore, electrification positively impacts the human aspect of operations. Electric-powered drills generate less noise, heat, vibration, and emissions than their diesel counterparts, making operations more environmentally friendly and less physically demanding for operators and maintenance staff.

The prime mover’s reduced maintenance requirements also decrease stress and fatigue. Consequently, drill and blast supervisors and other personnel can operate in safer conditions.

However, one of the main challenges for electric-powered rigs is less mobility compared with diesel-powered rigs.

“The challenge mainly comes with the cable reel,” says Subbiah. “Rotary blast hole drill rigs often have a large cable reel at the back end of the machine with a trailing cable that gets pulled and connected to a substation placed. Our machines receive the electric power from the grid through the substation to operate all the functions. Typically, there will be a blast every day or every other day, so machines must be cleared for these blasts.

“During blasting, there cannot be any people or equipment within a certain radius of the mine site — depending on country regulations. To accommodate this, these machines must be moved away. In the case of electric-powered drills, the entire rig must be moved manually or needs assistance to be moved. The advantage of diesel-powered rigs is their self-propulsion. They don’t need any external effort because the diesel engine is onboard, allowing them to move irrespective of location.”

Sandvik is continually working on innovative solutions to overcome the challenge of moving the electric drills during blasting.

“We are undertaking the modular design carefully so that converting a next-gen diesel-powered machine to an electric-powered one can be done simply in a mine workshop.”

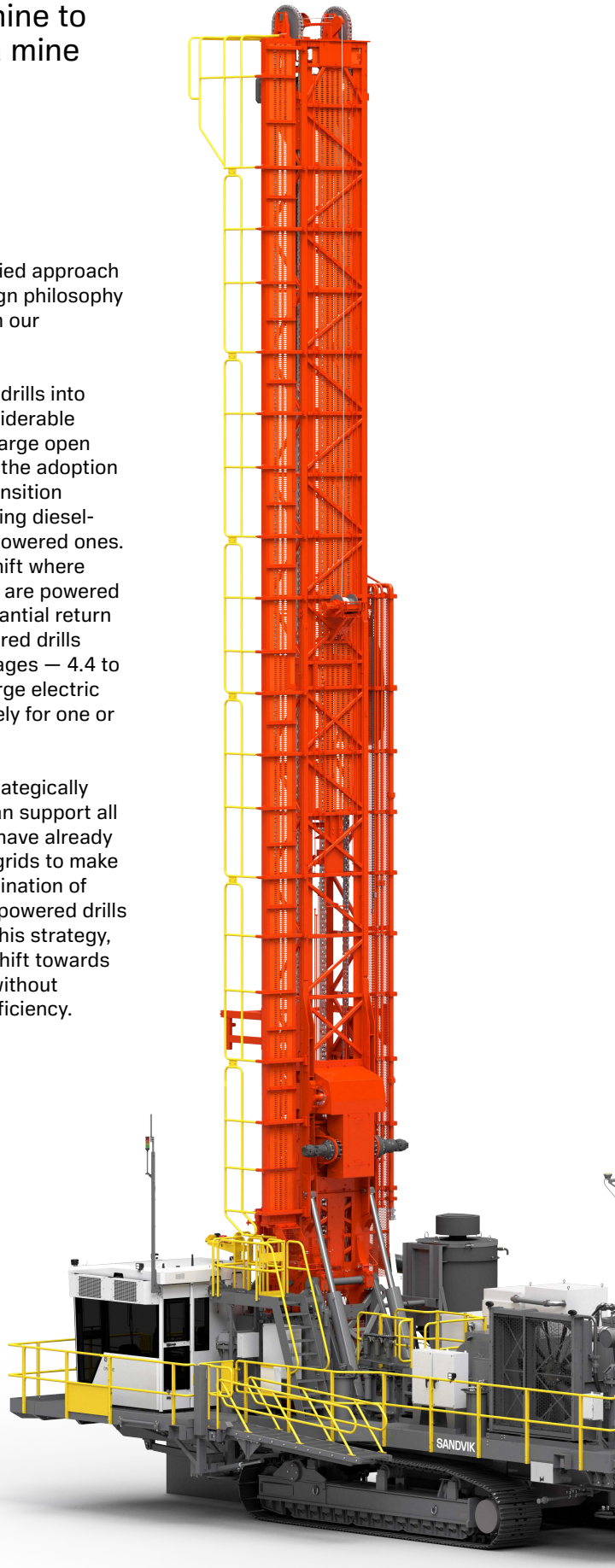
Modular design
Sandvik Mining and Rock Solutions is eager to make it a lot easier for mining companies to transition to electric-powered drill rigs from diesel-powered ones in the future. Modular design helps a lot in this transition. It has designed the electric motor power pack and the diesel power pack on a skid that can be swapped without replacing many components on the frame. Additionally, the piping, cooler package, and hydraulic system are all designed in a modular fashion, eliminating the need for extensive changes.

“You will see that our new platform is very modular,” says Subbiah. “We are undertaking the modular design carefully so that converting a next-gen diesel-powered machine to an electric-powered one can be done simply in a mine workshop rather than the manufacturer’s factory.

“In this way, we help to protect the asset’s life. The customer has the drill rig for the next 10-15 years, but they want to convert it to electric in two or three years. It will be a lot easier for them to do so in the future. They do not have to invest a huge sum on a new electric rig. That’s our goal. Our engineering team has done a fantastic job achieving it by introducing a modular design and a simplified approach to convert. Our modular design philosophy is our key differentiation from our competitors.”

Integrating electric-powered drills into a surface mine requires considerable effort and planning. For any large open pit surface mine considering the adoption of electric equipment, the transition should extend beyond replacing diesel-powered drills with electric-powered ones. It should involve a broader shift where multiple pieces of equipment are powered electrically to ensure a substantial return on investment. Electric-powered drills typically operate at high voltages — 4.4 to 7.2 kV — making installing large electric voltage supply lines exclusively for one or two drill rigs impractical.

In this way, mines need to strategically plan an electrical grid that can support all the equipment. Some mines have already begun developing their own grids to make this transition easier. A combination of diesel-powered and electric-powered drills is often deployed as part of this strategy, allowing mines to gradually shift towards more sustainable practices without compromising operational efficiency.



“Recently, Sandvik unveiled its smaller battery-electric concept surface top hammer drill rig and battery-electric concept surface DTH drill rig, paving the way for the eventual integration of battery technology into rotary blast hole drill rigs as battery technology continues to advance.”

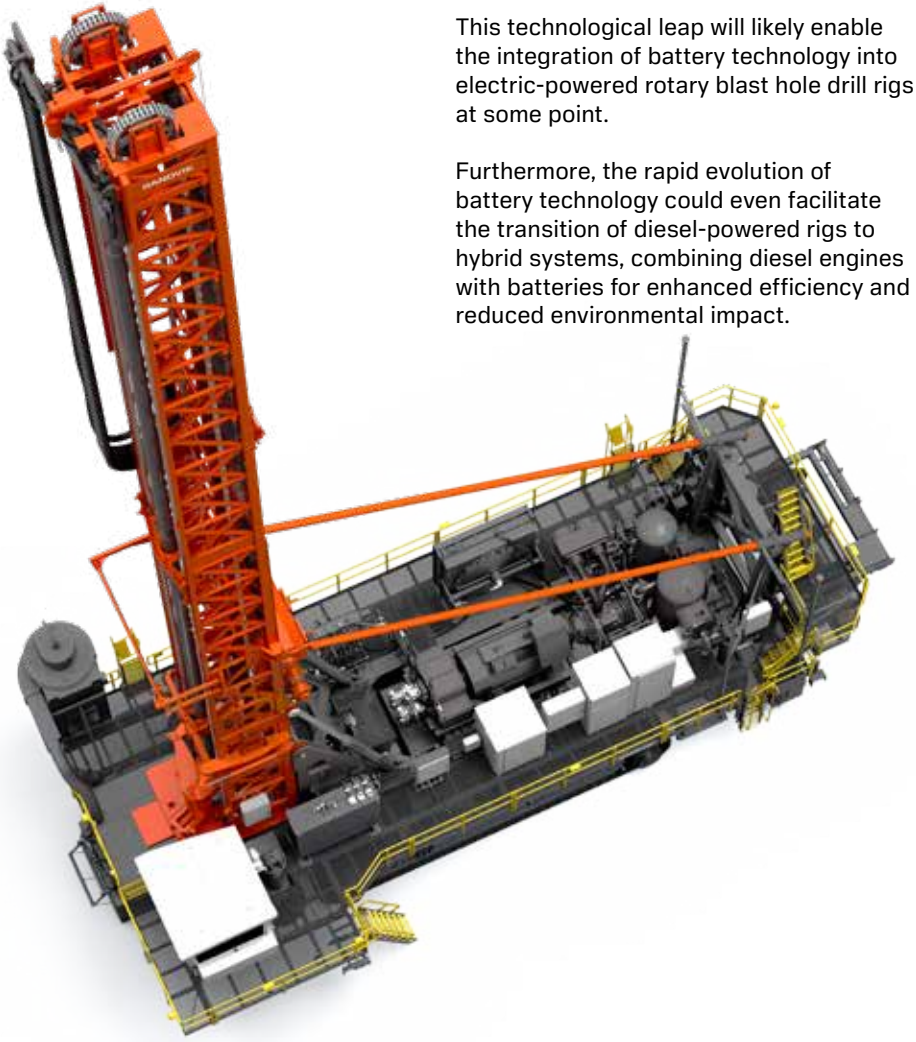
Battery-powered drills
Sandvik introduced its smaller top hammer battery-electric concept surface drill rig in May 2022. The rig was developed to support more sustainable drilling in construction applications.

Based on the lessons learned from that development, a second battery-electric concept surface drill rig was recently introduced, capable of drilling DTH holes up to 229 mm (9 inches).

Moreover, the power demand for large rotary drills is higher than that for surface drill rigs, and experts anticipate a substantial reduction in battery size, making a one-kilowatt battery more practical and manageable.

This technological leap will likely enable the integration of battery technology into electric-powered rotary blast hole drill rigs at some point.

Furthermore, the rapid evolution of battery technology could even facilitate the transition of diesel-powered rigs to hybrid systems, combining diesel engines with batteries for enhanced efficiency and reduced environmental impact.



The electrification of mainly diesel-powered machines is just one aspect of how the drilling process is changing. It could be seen as an interim step, looked at holistically and with a longer-term perspective. In the future, mining operations could be powered by a mix of alternative and sustainable fuel sources, including batteries, hydrogen, biodiesel, and biogas.

The transition to electric-powered drilling is a crucial milestone in the mining industry. However, this change requires patience and a commitment to adapt. The sector must maintain ground-based controls for operations involving the loading and unloading of cables. Furthermore, operating high-voltage electric equipment introduces the risk of electromagnetic interference among circuits. This demands a concerted effort to ensure that safety and reliability standards remain world-class.

Sandvik Mining and Rock Solutions has launched its first electrically powered iSeries rigs. The DR416iE, a powerful 1044 kW (1400 HP) drill with a 420-meter cable reel, is already in operation. The company is set to expand its electric fleet with the introduction of the DR413iE, DR412iE, and DR410iE models. These electric drills offer significant environmental benefits and can be deployed at any mining site.

However, any serious miner understands that radical steps must be taken to remain relevant in a century defined by our approach to energy. Drilling is one example of how the mining industry is transitioning from outdated, harmful activities towards cleaner, smarter processes. It is crucial for everyone involved in the future of mining to commit to sustainability, reusability, and recycling. Electric-powered drills are the future.