

We welcome a new idea of the future



by the **Comacchio** team

In the path towards a cleaner and smarter future for mining Comacchio is taking a major step introducing the first battery-powered drill rig for mining exploration operations.

As the world faces a climate crisis, creating a sustainable future for mining is rapidly becoming a priority for the industry. As part of their strategy for sustainable mining, top miners across the global market including Anglo American, Rio Tinto and BHP have enacted change towards carbon neutrality across all operations and have committed to net zero in direct and indirect emissions by 2050 or sooner. To reach such ambitious targets, companies are reviewing the equipment they use, trying to offset the adverse effects of pollution and reduced energy efficiency connected to the use of diesel-powered machines.

Building upon its extensive experience with the CX range, Comacchio introduced eGEO 405 – a fully-electric exploration drill rig using lithium-ion rechargeable batteries. The rig was first presented during the Bauma show in Munich in October 2022. It can be considered a milestone in the journey towards zero-emission drilling in exploration drilling programs around the world, explained Emanuele Comacchio, technical and sales manager at the company.

The ‘heart’ of the eGEO 405 drill is the battery pack, consisting of a modular battery system, delivering a total energy content of 52 kWh and reaching a nominal voltage of 350V. The battery system uses multiple subpacks in series, it is characterized by a high energy density, scalability and extensive safety features. The solution is said to be robust against harsh conditions and to score especially in applications that require high peak power, fast charging and a large number of charging cycles. The estimated lifespan is 2000 cycles. The battery system has a compact size and is placed on the rear part of the machine in a separate and exchangeable box, designed to be easily handled using a forklift, telehandler or other ancillary lifting equipment. The battery system should allow a runtime of up to eight hours, depending on soil conditions. To ensure

continuous operations even under ‘extreme load’ conditions, the rig is supplied with two swappable ‘power boxes’. Switching out a depleted battery with a fully charged one requires just a few minutes. The depleted batteries can be recharged on site using the mains supply or taken to a charging point and recharged there. Recharging to 80% can take as little as 30 minutes, depending on the starting level and the power supply capacity of the grid.

‘We have updated the battery system to include an on-board charging device (OBC). It is compatible with the single-phase and three-phase input voltage and it is designed to manage the flow of current from the charging station to the battery regulating the input current according to customer’s needs. This will allow the drillers to recharge the batteries while continuing working in plug-in mode,’ continues Mr Comacchio.

The low-voltage DC (direct current) power provided by the battery pack is changed into conventional AC (alternating current) by power inverters located on the sides of the rig, protected from vibration and heat and easily accessible for repair and maintenance operations. The inverters allow precise control of the flow of power to any of the rig’s AC motor loads that provide motive power for the rotary head, pumps and winches equipping the eGEO 405.

Unlike most of the competition, Comacchio has chosen to electrify all main loads of the drill rig through the use of permanent magnet synchronous machine (PMSM) technology. The electric PMSM motors offer smaller dimensions, lighter weight and higher efficiency as compared to conventional technology such as induction machines. The use of several motors (rather than one) brings the power supply directly to the point where it is needed, thus eliminating the losses due to energy dissipation and ensuring maximum efficiency of the system as a whole.

‘The biggest challenge in electrifying a drilling rig is integrating the batteries into a piece of equipment designed to accommodate a thermal powertrain. We developed the battery system and the power management from the ground up, including designing and implementing a software solution to effectively and safely manage power and energy between the batteries, the inverters and the electric motors powering the main loads of the rig. The power supply of the machine is controlled by a vehicle control unit (VCU) using CANBUS technology, allowing all the components to communicate with each other and managing the current flow from the battery according to the actual operating needs. The operating parameters of the machine can be viewed on a display located on the control panel,’ elaborates Mr Comacchio.

The rig is equipped with a 6500 daN (14 600 lb) pull mast with 3500 mm (11.4 ft) stroke, featuring a hands-free clamping/break-out system with a clamping range of 45–325 mm (1.8 in. to 12.8 in.). The high-performance rotary head can reach 850 daNm peak torque and a speed of 650 rpm. It can be operated in slow and fast gear, and the adjustment of torque and rpm according to the actual operating conditions can be carried out in an extremely precise manner. The machine on display at the Bauma industry event in Munich was equipped with a mud/water pump (with max flow rate 200 l/min and max pressure 45 bar), a 2000 kg (4500 lb) service winch, and a 600 kg (1320 lb) wireline winch. The eGEO 405 also features a rod rack holding up to twenty-eight 76 mm (3 in) rods with a max. length of 3 m (9.8 ft) and can be thus transported with a total of 84 m (276 ft) of rods on board. The overall dimensions of the eGEO 405 are very similar to the diesel-engine equivalent, keeping the machine as compact as possible to facilitate transport. The transport weight ranges between 8500 and



Electric
E GEO 405

↑ The Comacchio eGEO 405 features a modular battery system delivering a total energy content of 52 kWh and reaching a nominal voltage of 350V

9500 kg (18 750 and 20 950 lb), depending on accessories, including one battery pack.

Comacchio claims that the eGEO 405 is designed to perform as well if not better than the diesel-powered equivalent GEO 405. It can offer the same functionality and provide the maximum required power, regardless of drilling method, covering the full spectrum of applications connected with mineral exploration. Specifically, the eGEO 405 allows to carry out conventional and wireline coring using B-size, N-size, H-size and P-size rods at up to 350 m (1150 ft) depth. The machine can also be configured for RC drilling using DTH hammer, reaching 80–100 m (262–328 ft) depth. The multipurpose design of the rotary head allows to perform multiple drilling types with minor changes on the machine. This operational flexibility results in reduced unproductive time and lower total cost of ownership.

The safety features of the machine include protection against moving parts, such as interlocking guard meeting the European requirements of EN 16228. Furthermore, the eGEO 405 can be equipped with data logging system including ComNect, a remote monitoring software developed by Comacchio providing data that can be used for a variety of machine diagnostics and operational condition analyses.

The sustainability benefits are enormous and are expected to be a driving factor in the adoption of this kind of rigs. The use of eGEO 405 is to save up to 372 kg of CO₂, up to 0.62 g of particulate matter related emissions and is estimated to save up to 130 l of diesel over an eight-hour workday. Ideally, if the batteries are charged from green energy sources, the drill generates complete zero emissions.


‘Thanks to the *electric motor*, the adjustment of torque and rpm according to the actual operating conditions can be carried out in an *extremely precise manner*.’

Other benefits include:

1. **Higher energy efficiency.** Diesel-run hydraulic drill rigs are estimated to lose 60% of energy due to the engine and another 30% due to the hydraulic system. Electric engines deliver 90% of energy at the output shaft and are therefore considered the most efficient option. Moreover, the use of electric motors eliminates energy losses and fuel consumption connected to idling times of both hydraulic pumps and diesel engines. With an electric drill rig, the current output from the battery is provided according to the actual load, accumulating operating hours only when truly in operation.
2. **Low noise.** Noise pollution is an underestimated threat to health and safety. eGEO O405 will help remove noise distraction, enhancing both productivity and safety on site.
3. **Reduced maintenance required with electric drives compared to conventional combustion engines.** Electric drill rigs have far fewer parts than their diesel alternatives. This means less breakdowns, longer service intervals and less maintenance. Over the course of their lives, the total cost of ownership for an electric drill rig is cut considerably in comparison to diesel-run variations. Additionally, the lifetime of an electric motor is much longer.
4. **Optimal operational precision.** High-performance motor control characterizing the electric PMSM motors equipping the rotary head and the main components of the rig provide accurate speed and torque control, offer smooth rotation over the entire speed range and have the advantage of sustaining full torque at zero speed, and fast acceleration and deceleration. This enables greater control of drilling parameters resulting in faster and better holes.

'While creating the eGEO 405 we have chosen the most proven electrification technology available on the market, in order to provide reliable operation in harsh operating conditions associated with exploration projects,' concludes Emanuele Comacchio. 'We are approaching companies that are willing to become early adopters of new technologies. Carbon reductions will become a more important differentiator as many mining companies publicly commit to ambitious net zero targets and want to score well on key Environment, Sustainability and Governance (ESG) performance indicators, which is increasingly important to investors. Such ambitions will likely accelerate in the next years and Comacchio is committed to exploring new solutions including not only purely battery-electric drives, but also hydrogen-powered motors. The eGEO 405 was designed with a view to future developments that include the use of fuel cells powered by hydrogen instead of drawing electricity from the battery. This is the first step of a long path towards a new idea of the future of mining exploration'.

About the company

Comacchio is a world-renowned designer and manufacturer of drill rigs for a vast range of applications. Born in 1986, Comacchio is a family-run company, operating from its headquarters in Riese Pio X (Italy). The company's ability to assimilate ideas, insights and specific requirements coming from the market has allowed creating an innovative and differentiated range of products, offering a range of features, options and enhanced automation solutions designed for optimal safety, reliability and performance. 



↑ The multipurpose design of the rotary head equipping the eGEO 405 allows to perform multiple drilling types with minor changes on the machine



↑ The battery system powering the eGEO 405 is placed on the rear part of the machine in a separate box designed to be easily exchangeable using a forklift or telehandler

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