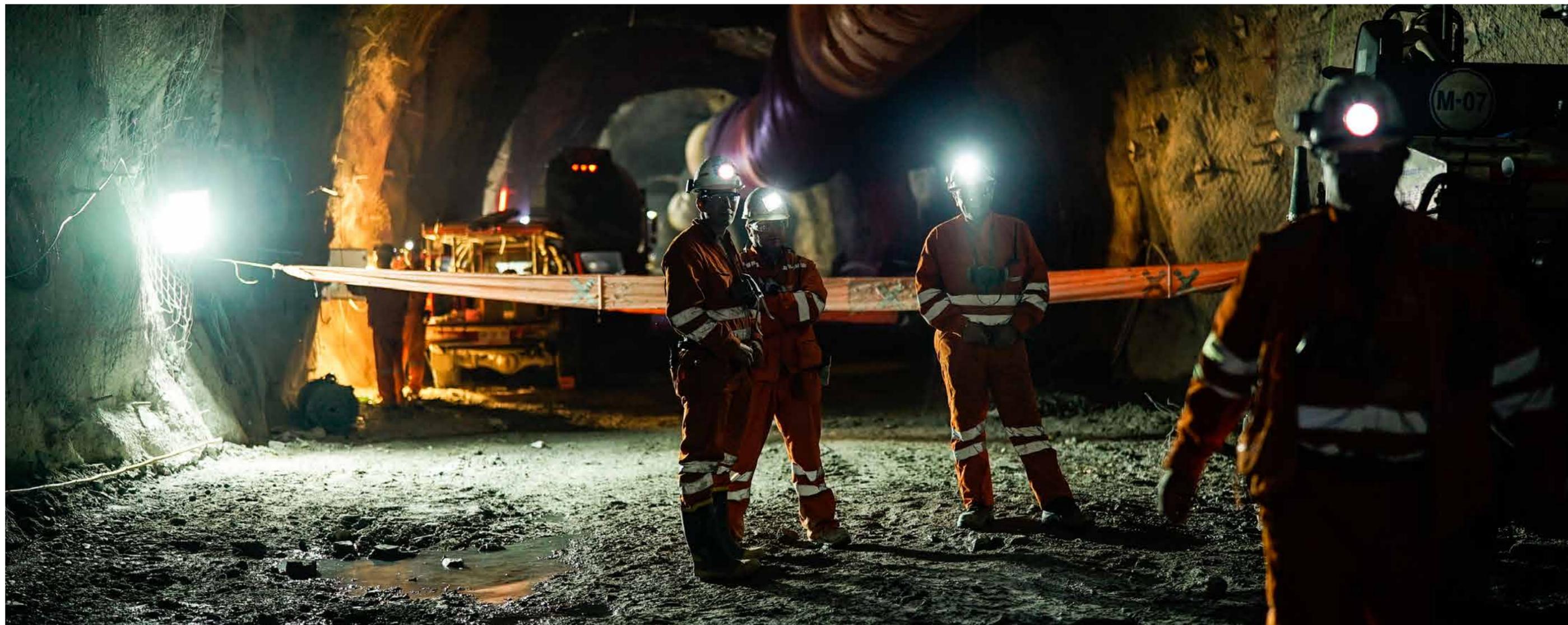


# Codelco El Teniente

CHILE'S FLAGSHIP MINE GOES  
FROM STRENGTH TO STRENGTH



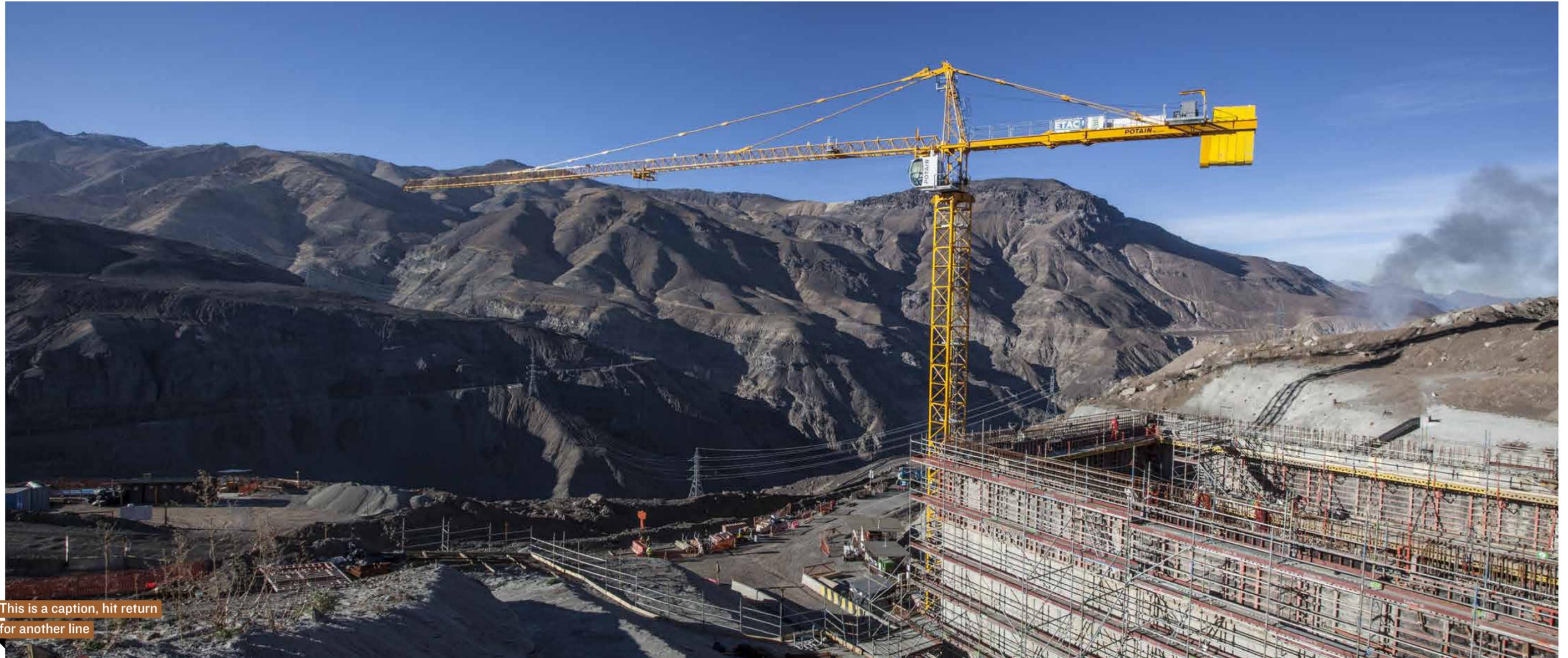


Codelco El Teniente

# CHILE'S FLAGSHIP MINE GOES FROM STRENGTH TO STRENGTH

*The rise in copper prices has allowed Chile to ride out some of the economic storm wrought by the Coronavirus pandemic*

RESEARCH BY *Eurides Lopes*



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for another line

**W**hen Business Excellence last visited El Teniente in June 2019, global copper prices were hovering at around \$6,000 per ton, in a year of price declines for all base metals. What a difference two years have made; in 2021, copper is trading at close to \$10,000 per ton, and continues on a consistent upward trend that began in the first quarter of 2020 - just as Covid-19 was arriving in Latin America.

Business Excellence decided it was time to revisit the mine, which has already begun

commercial production from the \$759 million phase one expansion project at El Teniente mine, 15 months ahead of schedule. With ore reserves estimated at 157 million tonnes and a copper grade of 0.75%, the new section of El Teniente - Recursos Norte - represents yet another landmark for the world's largest copper producer.

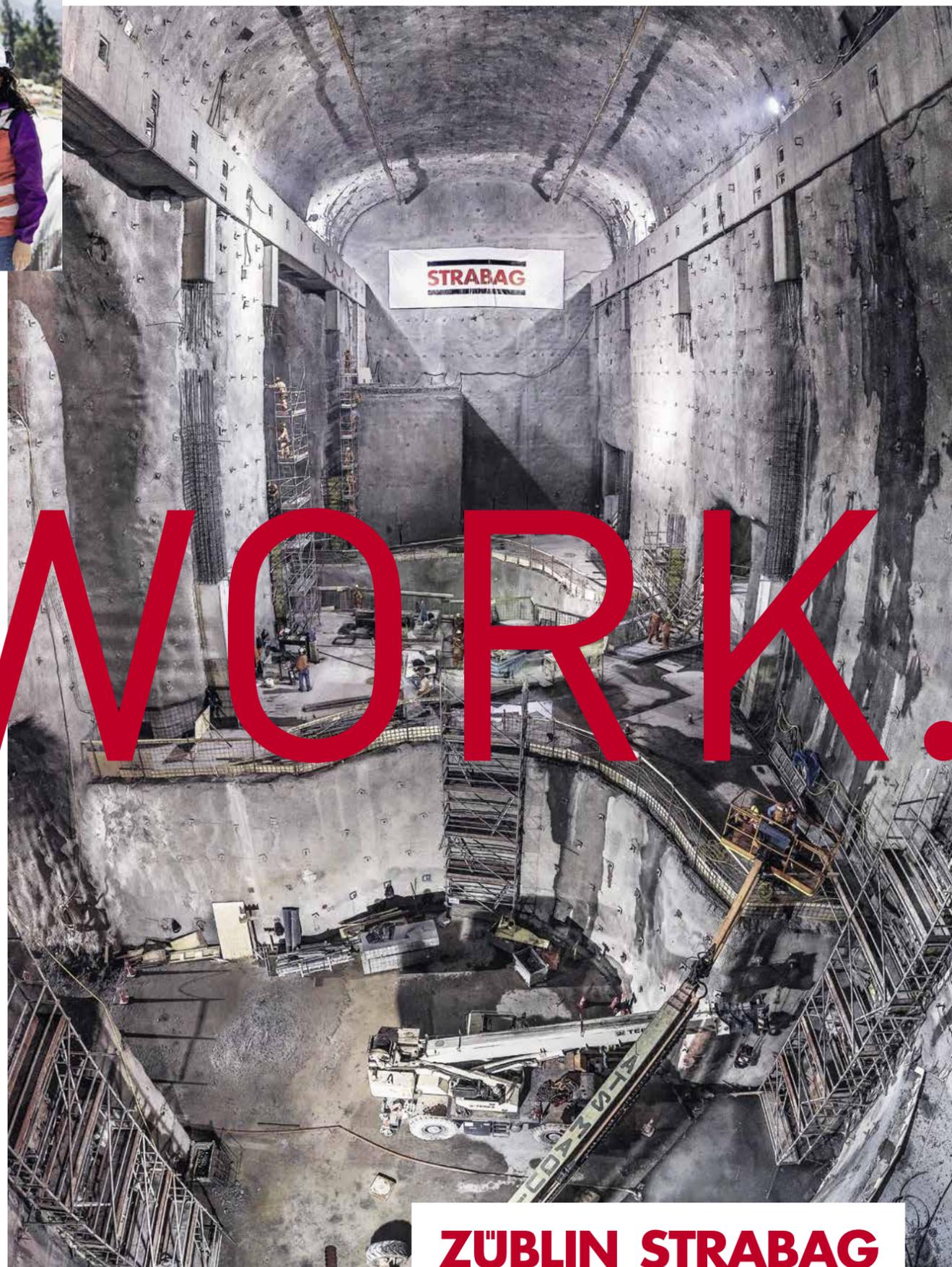
#### **Ongoing Developments**

The arrival of Recursos Norte ahead of schedule allows Codelco to focus its efforts on the

*“This new section,  
called Recursos Norte,  
has estimated  
ores of 157 million  
tons and a copper  
grade of 0.7%”*

remaining phases of El Teniente: the Diamante and Andesite projects - both already under construction - and the future Andres Norte project. Combined, these components of the projects involve an investment of US \$1,243 million - further evidence of the commitment of Codelco to El Teniente's future.

The overall \$3.4 billion-expansion project, which is expected to extend its productive life by 50 years, is part of an ambitious, 10-year, \$39 billion investment drive at Codelco to open new projects and overhaul older mines.



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When the expansion is finished in 2023, El Teniente's output of 500,000 tonnes of copper a year will make it one of the world's top five copper mines in terms of output.

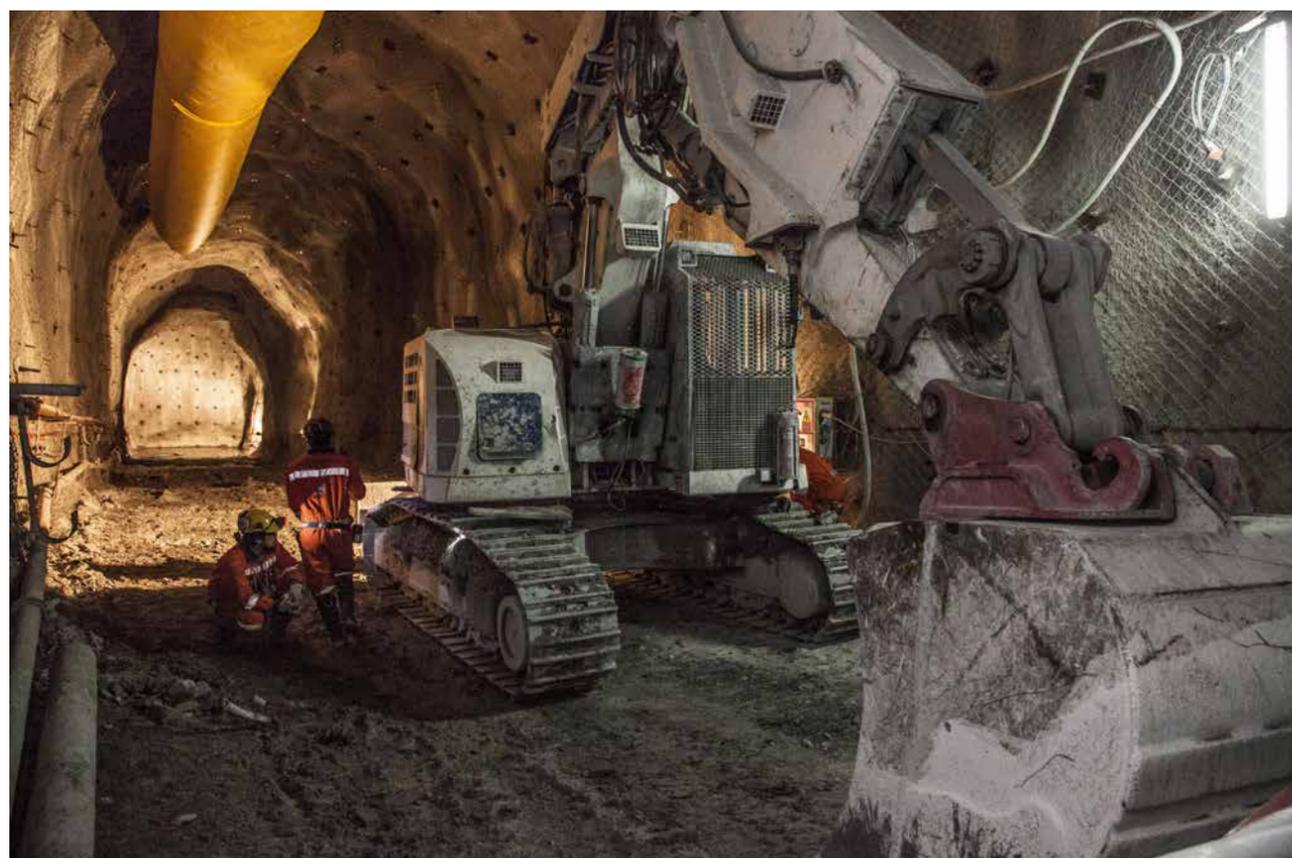
As Juan Benavides, President of the Codelco board of directors, says: "This portfolio will allow the current ranges of surpluses of this division to increase, which are around US \$ 1,100 million per year, because

our commitment is to increase contributions to the State of Chile,"

**Advanced Analytics**

Advanced Analytics will form a central role at the mine, significantly improving its capacity to process materials. Artificial intelligence and ongoing analysis of the mine's output will allow each of the 12 mills in this operations center to

*“The next phase, at the Diamante and Andesita mines will involve an investment of US\$1,243 million and allow our surpluses to increase US \$1,100 million per year, because our commitment is to increase contributions to the State of Chile”*



increase its performance by four tons per hour. Codelco estimates that the additional operational data, when combined with AI and machine learning, has the potential to improve the ore processing of 12 mills by around 2%.

"This means that if a mill processes 210 tons per hour, it will have a profit of four tons. If we multiply it by 12 mills it is a significant number", says Daniela Campos, Superintendent of Conventional Processes at El Teniente, before adding: "Thanks to these data, the operators who are in the Integrated Operations

**Did you know?**

Advanced analytics will allow each of our 12 mills to increase performance by around four tons per hour. For example, it will enable us to significantly maximize our conventional grinding process

Center (CIO), in Rancagua, capture opportunities and warn about operational movements to generate value".

**Pushing Through The Pandemic**

Thanks to the digitization of the mills at El Teniente and elsewhere within Codelco, the impact of Covid-19 on operations has been minimised. As Alvaro Garcia, Vice President of Technology and Business Process Automation points out: "We are a highly automated company, administratively and operationally.

## A Builder of Trust

▶ STRABAG, with its wholly-owned subsidiary ZÜBLIN, is one of the largest construction companies in Europe, including in its home markets of Germany and Austria. The STRABAG Group had a global production volume of around €15.4 billion in 2020. It has been building trust in the Chilean mining market since its arrival more than 30 years ago and was engaged in close to 100 mining projects.

Its relationship with Codelco goes back to 1992 and over the decades ZÜBLIN has become one of the leading underground contractors in Chile.

In 2019, the group employed up to 7,000 people in Chile, working on its top five contracts. That year ZÜBLIN closed with the completion of the first underground level in Chuquicamata for Codelco. Here, the team reached peak advances of 1,800 meters per month, and at the same time, the Health and Safety culture and standards of the company were officially recognized and awarded for the exemplary results achieved. Currently ZÜBLIN is executing two contracts in Nuevo Nivel Mina in El Teniente, also for Codelco.

ZÜBLIN's vast experience and flexible organizational structures allow it to engage in long term contracts like Candelaria Norte and Sur for Lundin Mining Corporation, spanning

the entire mining cycle and processes, from preparation and construction to operation and logistics. During these years it has also gained extensive experience in a variety of mining techniques.

The Group is well known for conducting large engineering projects – as principal contractor in the green-energy Alto Maipo hydroelectric project in Chile. STRABAG is currently completing 74km of tunnels, shafts and two underground power houses. This mega-project allowed the company to show its exceptional high performance ability and quality construction in the South American market, from TBM tunnelling, D&B tunnelling, shaft construction, earth- and civil works and more, implemented through its own resources and international expertise.

Beyond Facts and figures, it is evident that the close relationship enjoyed between Codelco and ZÜBLIN results from the joint commitment to the highest standards possible rooted in shared values.

Mario Theurl, General Manager of STRABAG and ZÜBLIN Chile explained: "It is an honor to be trusted as Codelco's partner on these complex projects, contributing directly to the company's core business and continued success. The

"The shared values, great communication and the aligned goal of continuous improvement over the years has built up a strong alliance"

**ZÜBLIN STRABAG**  
TEAMS WORK.



shared values, great communication and the aligned goal of continuous improvement over the years has built up a strong alliance."

Lastly, Codelco and other current and future partners can count on two other important strengths.

Firstly, the new Chilean-based machine workshop of STRABAG and ZÜBLIN, which is one of a kind in South America. More than 1,500 pieces of equipment used from traditional excavation to TBMs can be repaired or modified, optimizing supply chains and time. An example of sustainability run by the minds and hearts of exceptional people.

Secondly, the direct support from the company's European Central Technical Division with more than 1,000 engineers is dedicated exclusively to innovation and materials design.

"Innovation and sustainability are core values of our company and these synergies that we share with our clients will become even more important and evident in future projects," Mario Theurl said. ■

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*“We installed thermal cameras in our operations and automated our health forms to control access to operations, and all employees download our My Codelco application.”*

We’ve worked on developing the strictest sanitary measures in our work centers that include thermal cameras, and we’ve automated our health forms through our My Codelco App directly on each employee’s cell phone.”

Furthermore, in the first wave of Covid-19, the El Teniente Stadium sports center

became a field hospital for those infected of medium complexity and today, in the second onslaught of the virus, the enclosure became the main vaccination center in Rancagua and plans are afoot to expand it to make it the largest in the region, with more than 4,000 daily inoculations.

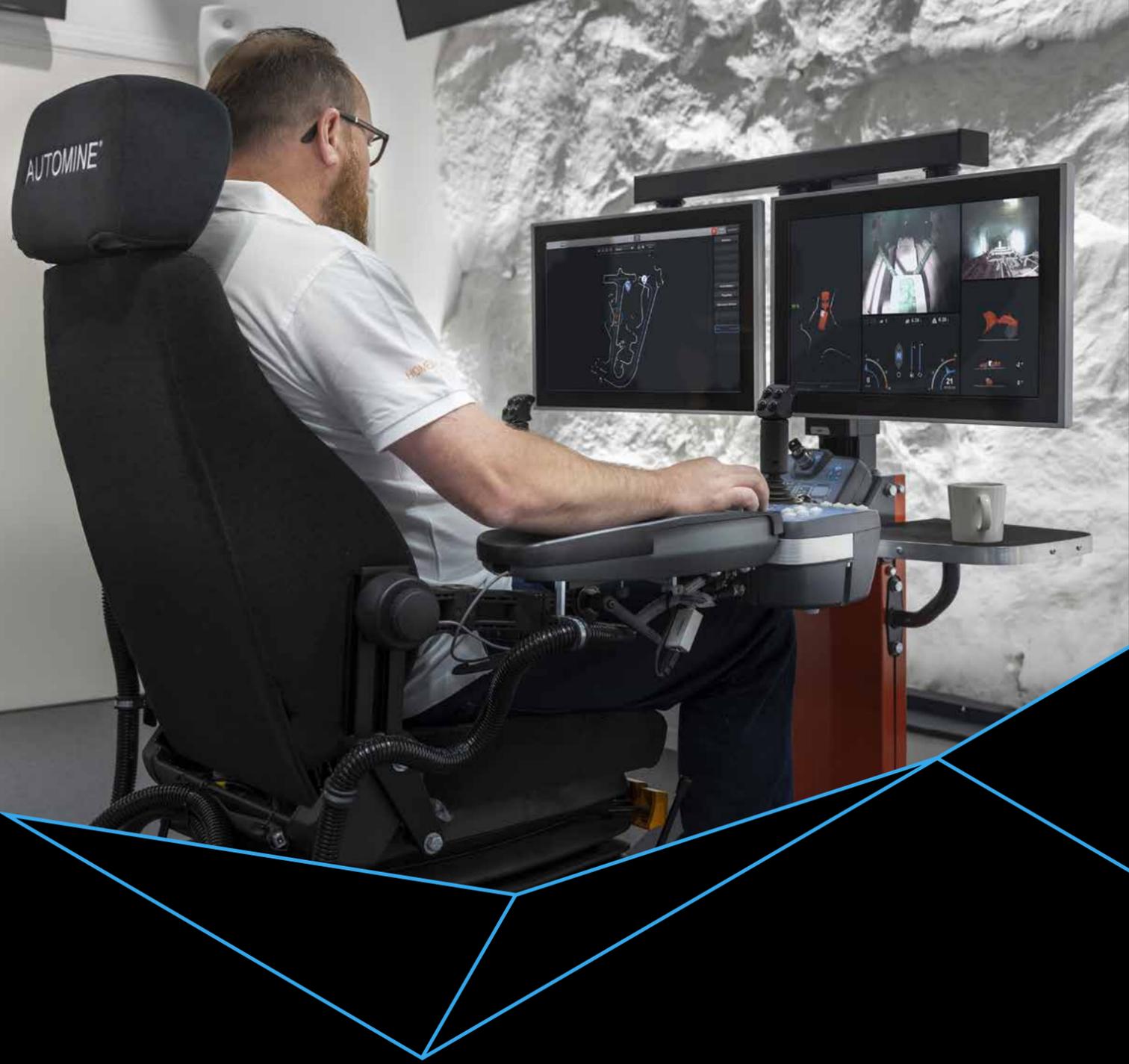
**Corporate Responsibility**

2020 also marked the sixth consecutive year that Codelco led the rankings of the national mining sector in terms of corporate social responsibility and corporate governance. It also ranked 19th among 100 companies globally. Speaking of the results, Renato Fernández, Codelco’s Vice President of Corporate Affairs and Sustainability said: “We are proud to lead the industry ranking in what has been a challenging year, in which with responsibility and commitment we managed to generate the resources that our country so badly needs.”

**Did you know?**

Codelco has delivered over 1,700 security kits for the inhabitants of nearby Coya, providing each one with one litre of liquid soap, alcohol gel, and disposable masks

The ranking reflects the work that Codelco continues to do in the areas of CSR and corporate. A good case in point is its Coya Seguro plan, which delivered 1,700 security kits for the inhabitants of Coya. This made it possible for all households in the area to have at least 1 liter of liquid soap, alcohol gel and disposable masks. In addition, it distributed a special backpack for 400 students in local schools with all the elements so that they can safely go to class. Of these gestures, Mr. Renato Fernández says: “with this we want to give peace of mind to 100 percent of the inhabitants of Coya by



## AUTOMINE® SMART WAY OF MINING

AutoMine® Underground for Loading and Hauling is an automation system for autonomous and tele-remote operation for a wide range of Sandvik loaders and trucks. The automation system is scaled from tele-remote or autonomous operation of a single machine to multi-machine control and full fleet automation with automatic mission and traffic control capability.



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## Sandvik continues to support Codelco's automation and digitalization journey

▶ The collaboration between Sandvik and Codelco on autonomous mining equipment has a long history and it keeps on widening to support Codelco's vision in creating the most sophisticated mines in the world. Codelco's objective is to dramatically increase the productivity, safety, efficiency and sustainability of its operations with the AutoMine® automation system and continue its 10-year strategic program to prolong the life of its existing mines.

“Being able to use mining automation technology that is well proven as well as working with a supplier that understands our needs and is capable of adapting to our operating philosophy are key drivers for Codelco's operations”

Sandvik and Codelco started their automation journey together at El Teniente with the first-ever AutoMine® Loading system installation in 2004. The AutoMine® system is already in operation at Diablo Regimiento and Panel 2 blocks of the El Teniente mine. Sandvik Mining and Rock Solutions delivers its AutoMine® Fleet system to automate a new fleet of Sandvik loaders also at Codelco's Pacifico Superior and Pilar Norte GTI, which are part of the El Teniente mine in Chile.

AutoMine® Fleet is a highly advanced automation system for a fleet of underground loaders and trucks sharing the same automated production area. It provides automatic mission control and traffic management for the equipment fleet,



while system operators remotely supervise the process. The system enables Codelco to operate its new fleet of Sandvik LH517i and Sandvik LH62li loaders autonomously at the El Teniente mine, one of the world's largest underground copper mines.

“Being able to use mining automation technology that is well proven as well as working with a supplier that understands our needs and is capable of adapting to our operating philosophy are key drivers for Codelco's operations,” says Juan Mariscal, Senior Business Manager, Codelco. “That is why we have chosen our long-term partner Sandvik to go on this journey with us. Above all, Sandvik's enhanced local presence and expertise will ensure successful implementation of these projects and strong support.” ■

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*“Codelco’s partners and suppliers at El Teniente read like a who’s who list of mining industry expertise”*

having the basic elements to be able to carry out their activities safely during the pandemic.

**Supply Partners**

As was the case the last time Business Excellence spoke with Codelco, they are keen to emphasize the importance of their supply partners both to the upgrade at El Teniente, and their ongoing support in general. They include Sandvik, which provided an automated

fleet for El Teniente, and Metso, which provides crushing and material handling equipment. Meanwhile, Strabag has also been centrally involved in the tunnelling works since 2014.

Elsewhere, Grupo OH is responsible for the construction of the wall reinforcement in the belt tunnel, Datapar S.A. provided the 100% electric taxi bus line ferrying employees to and from the mine, and a mixture of local companies provide essential services such as



*“The contribution El Teniente makes to Chile stands to be generational”*

engineering consulting and design services. These include Spintecnologies Engineering Services, GHH CHILE SPA, ARCADIS CHILE S.P.A. and CEMOSA.

**The Future**

In the short term, the company aims to have 10% female staff by the end of 2021, by which time it plans to produce 150 thousand tonnes daily. Rodrigo Andrades, Codelco's Mining Manager says of this aim: “Our 2021 aspiration is in line with what our general manager entrusted to us to reach 500 thousand metric tons of fine copper per year. To achieve this, we must aim for the processing of 150 thousand tons of material per day, which we should achieve in the second semester “

In the mid- to long-term, automation appears to be one of the critical success factors for El Teniente and the other mines in Codelco's portfolio. This will help El Teniente on two levels - both in driving down operational costs, and in improving efficiency at the mine. Chile has long recognised the importance of copper to the country's ongoing success. All anyone has to do is to follow the progress at El Teniente to see that this is the case. **BE**

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