T 284 Trolley

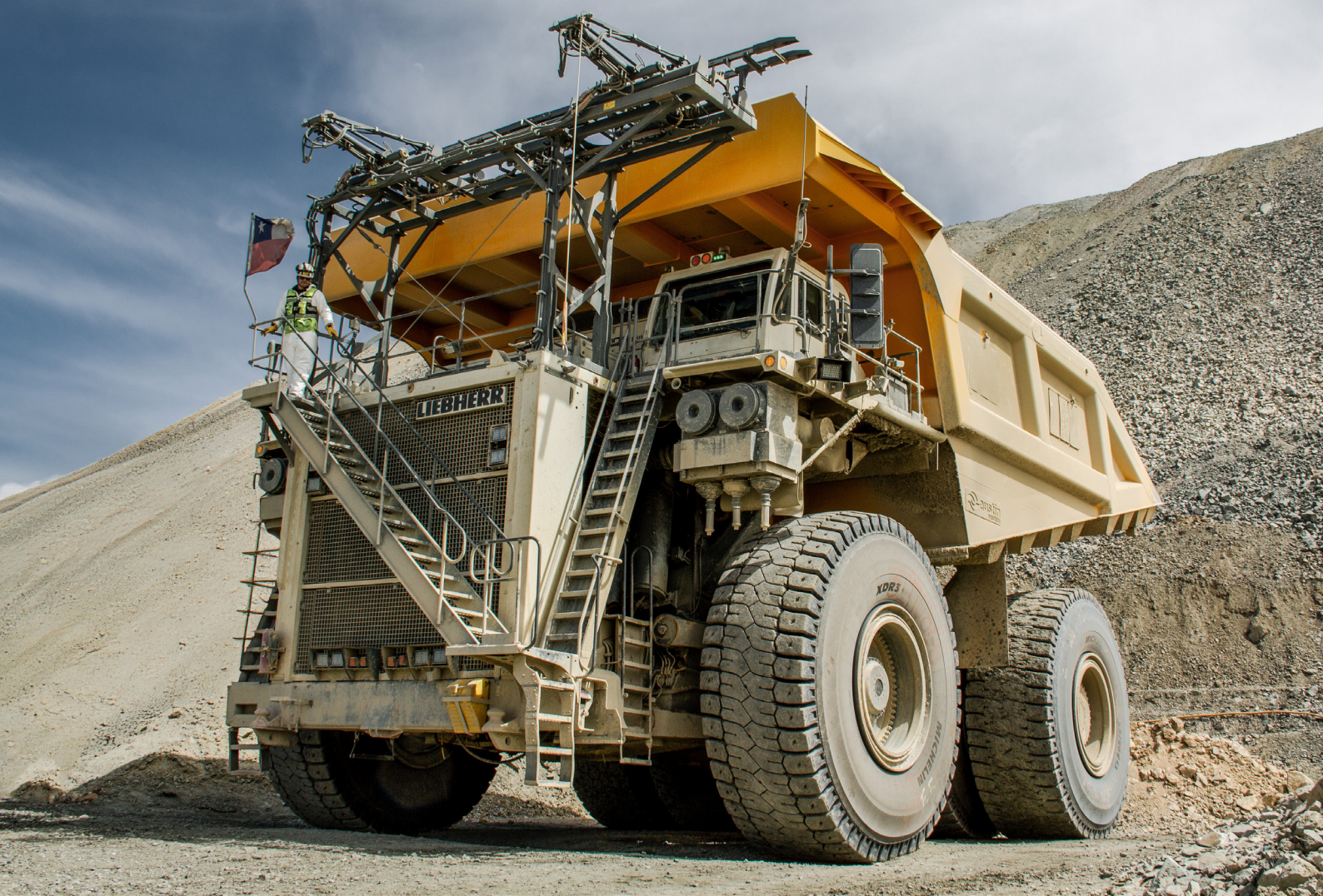
Job report:

Mine site electrification

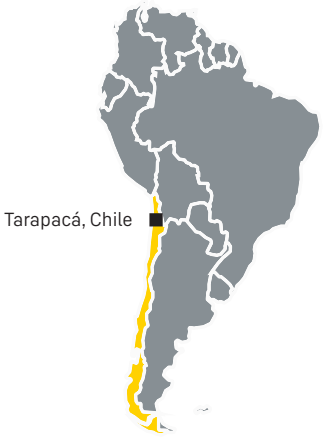
The Liebherr T 284 with Trolley Assist at Collahuasi, Chile

LIEBHERR

Decarbonisation



Situation



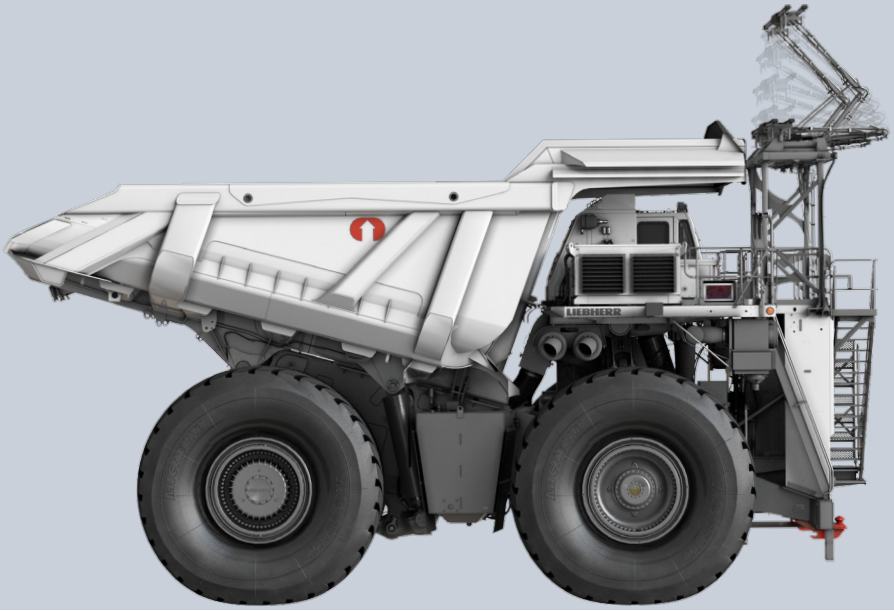
Compañía Minera Doña Inés de Collahuasi (Collahuasi) is an open-pit mine in the Tarapacá region of northern Chile. Located at over 4,500 m above sea level, Collahuasi is one of the largest copper mines in the world. Current mining operations started in 1999, but commercial mining in the area dates back to 1880. Collahuasi is dedicated to the extraction and production of copper concentrate and molybdenum concentrate. Its production levels and extensive mineral resources place it among the six main copper producers in the world and the second largest in Chile.

Collahuasi and Liebherr's relationship spans more than a decade and is built on reliable equipment performance, responsive support and technical collaboration. Liebherr haul trucks have operated at the mine since 2010, starting with a fleet of T 282 C 360-tonne trucks with T 284 ultra-class trucks joining the fleet in 2017. Collahuasi's current Liebherr fleet includes three T 282 Cs and 13 T 284s.

Sustainability is a central part of Collahuasi's operations and the mine aims to achieve net zero CO_2e emissions by 2040 for scopes 1 (direct emissions from fossil fuels) and 2 (indirect emissions from electricity consumption). To support Collahuasi in meeting these goals, Liebherr provided the mine with a full trolley solution. This included a one-kilometre trolley line at 10 % grade, two 5.5 MW transformers, overhead line and masts, four existing T 284 trucks retrofitted with the Trolley Assist system and training and support for the mine's employees.

The T 284

The T 284 is the lightest and most capable truck in the 360-tonne class. Built to operate in the most difficult mining conditions, the T 284 has proven its durability over 2.5 million operating hours in a wide range of climates. With its 363-tonne payload – one of the highest payload capacities in the 360-tonne class – the T 284 lowers cost per tonne with every haul cycle by moving more material than other trucks its class, improving efficiency and reducing fuel costs. The T 284 has also been used successfully in several of Liebherr's previous trolley projects in Panama and Zambia.



Payload class
360 tonne

Gross vehicle weight
605 tonne

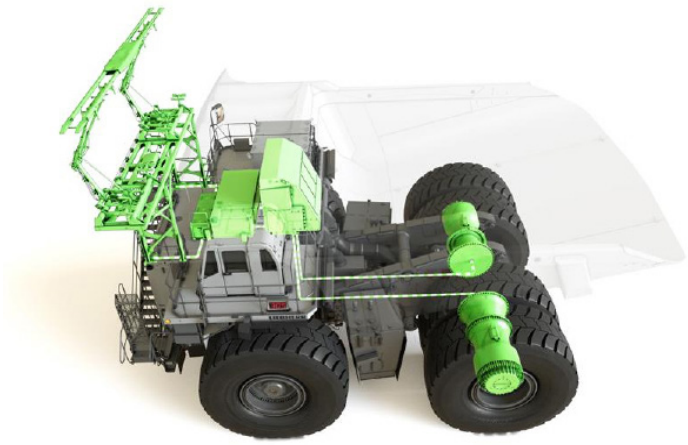
Empty vehicle weight
242 tonne

Gross power
Up to 3,000 kW

Max speed
64 km/hr

Trolley spotlight

Trolley is an example of a dynamic power transfer system. These systems allow mining trucks to use electricity from the mine's electrical grid as their power source, providing dynamic charging for trucks powered by battery technology and reducing the amount of fuel burned by trucks with diesel combustion engines. To tap into the mine's power grid, the trucks connect to an overhead trolley line via a pantograph and utilise the grid's energy for propulsion. When connected to a trolley line, more power is directed to the wheel motors, increasing speed on grade due to the diesel-electric configuration of the T 284.



Onsite performance

Study conditions

After training and commissioning were completed in July 2025, a production study at Collahuasi was conducted by application engineers from Liebherr Mining in October 2025.

The goal of the study was to measure the speed, cycle time and fuel consumption of the trucks operating on the trolley line. The study was conducted under normal operating conditions, with several loading points used and all trucks – both trolley-powered and solely diesel-powered – travelling to the same waste dump using the trolley ramp.

The study analysed truck performance across 15 cycles on the same nine-kilometre section of the site's haul road network, which included several loading points and the same waste dump. Of the 15 cycles recorded, 11 were completed by trucks connected to the trolley system and four completed using only diesel power.

Productivity

When the T 284s were operating under trolley, the average time to climb the ramp was 1.88 minutes – 1.36 minutes faster than the 3.24 minutes it took the trucks using only diesel power. This 42 % decrease in ramp cycle time was a result of the increased speed on grade enabled by the trolley connection.

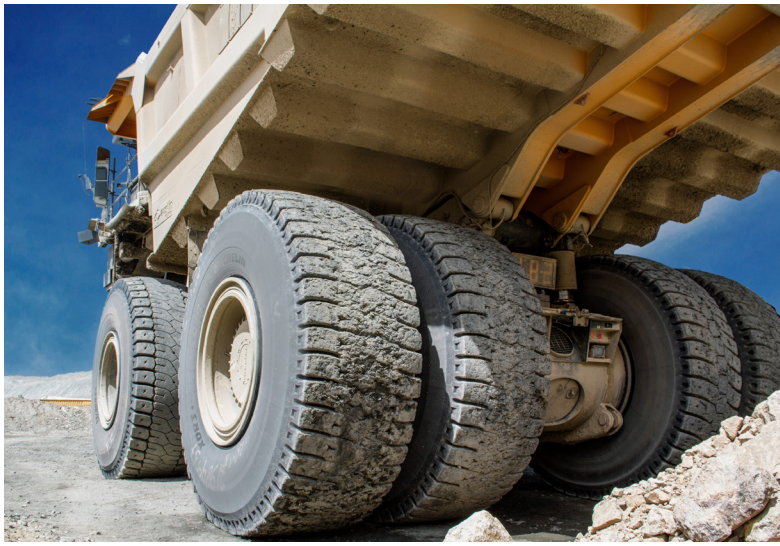
42 %
decrease in ramp cycle time

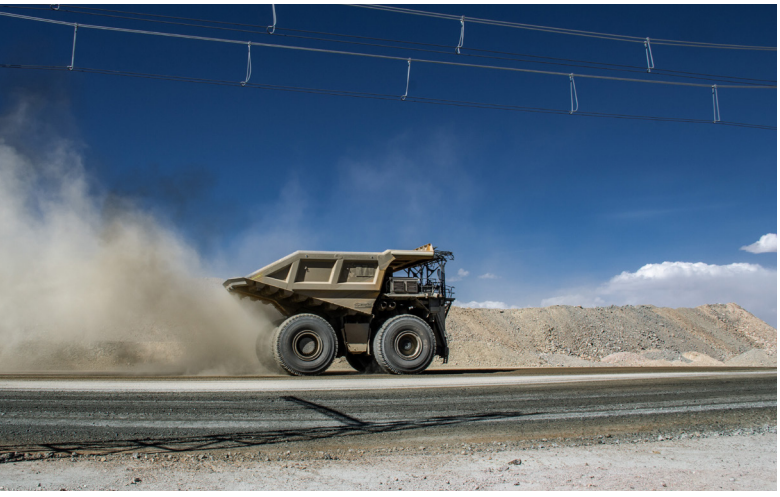
Trucks utilising trolley reached an average speed of 18.0 km/hr, while the average speed of the trucks operating on diesel power alone was 42 % slower, reaching approximately 10.4 km/hr. Assuming a 60-minute working hour and that each truck was carrying the nominal payload, the trucks operating under trolley moved 667.2 tonnes per operating hour. Compared to the trucks relying solely on diesel power, which moved 638.5 tonnes per operating hour, the trolley trucks were 4.5 % more productive than their diesel counterparts.

Fuel consumption

30 litres
saved per haul cycle

When the trucks were connected to the trolley line, all propulsion energy came from the electrical grid, not the trucks' diesel engine. This allowed the engines to drop to idle, which used significantly less fuel. When travelling on the ramp, the trucks connected to the trolley line consumed approximately 1.8 litres of fuel in idle – 94 % less than the 31.8 litres of fuel consumed by the trucks operating at 100 % engine load under diesel power. This saved approximately 30 litres of fuel per haul cycle.





26 %
decrease in fuel consumption*

Based on these figures, the fuel consumption rate for trucks under trolley was 57 L/hr – more than 90 % lower than the 589 L/hr fuel consumption rate of the trucks operating without trolley. Over an entire haul cycle, the trolley-equipped trucks saw a 26 % decrease in fuel consumption.

*average fuel savings over complete haul cycle

CO_2e emissions

Use of the trolley significantly reduced fuel burn during the most intensive portion of the haul cycle. The trolley trucks' decreased fuel burn also resulted in lower CO_2e emissions when travelling on the ramp. Under trolley, the trucks emitted only 4.89 kg CO_2e – 94 % fewer emissions than the 87 kg CO_2e emitted by the trucks operating solely under diesel power.

CO_2e

26 %

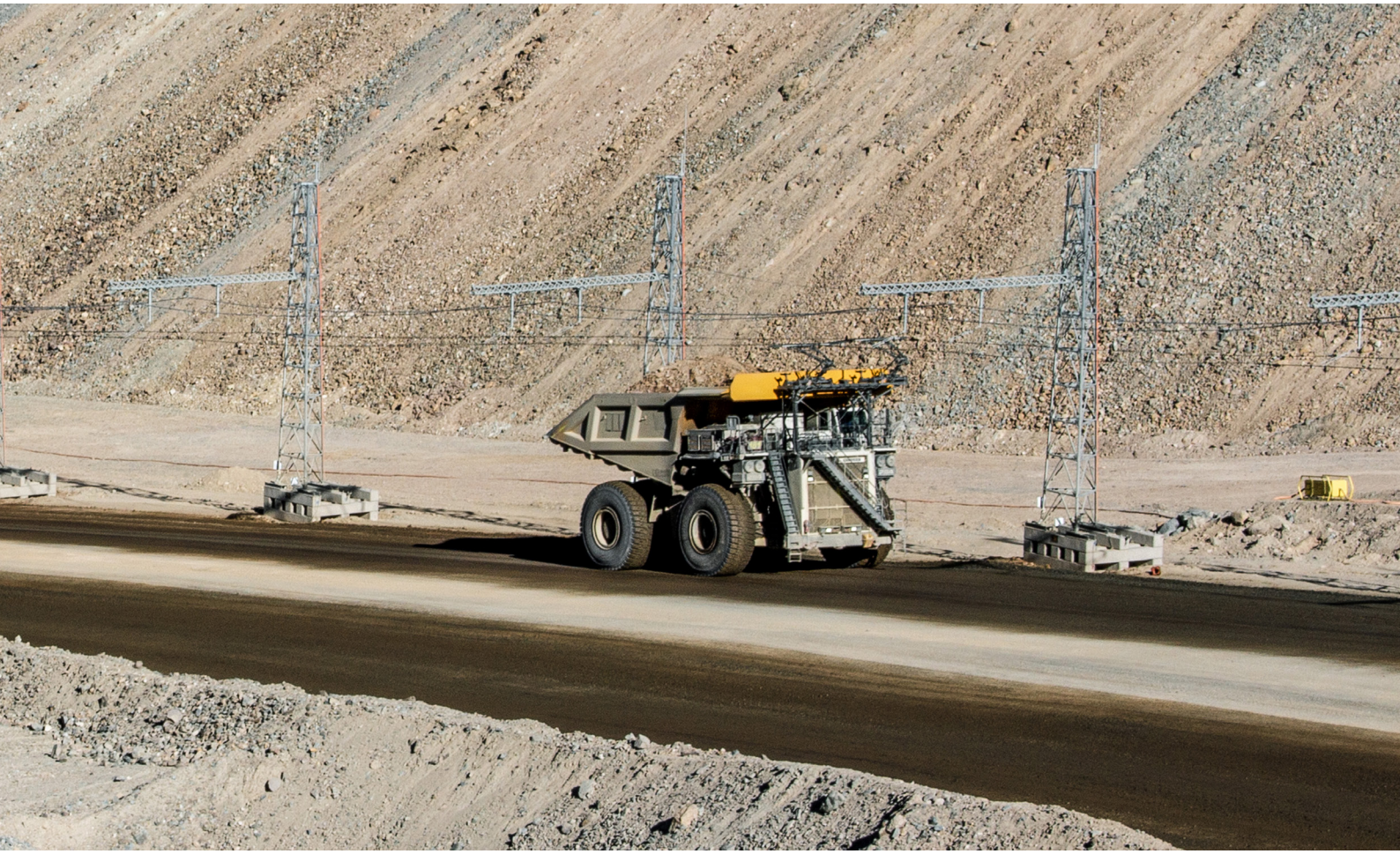
decrease in CO_2e emissions*

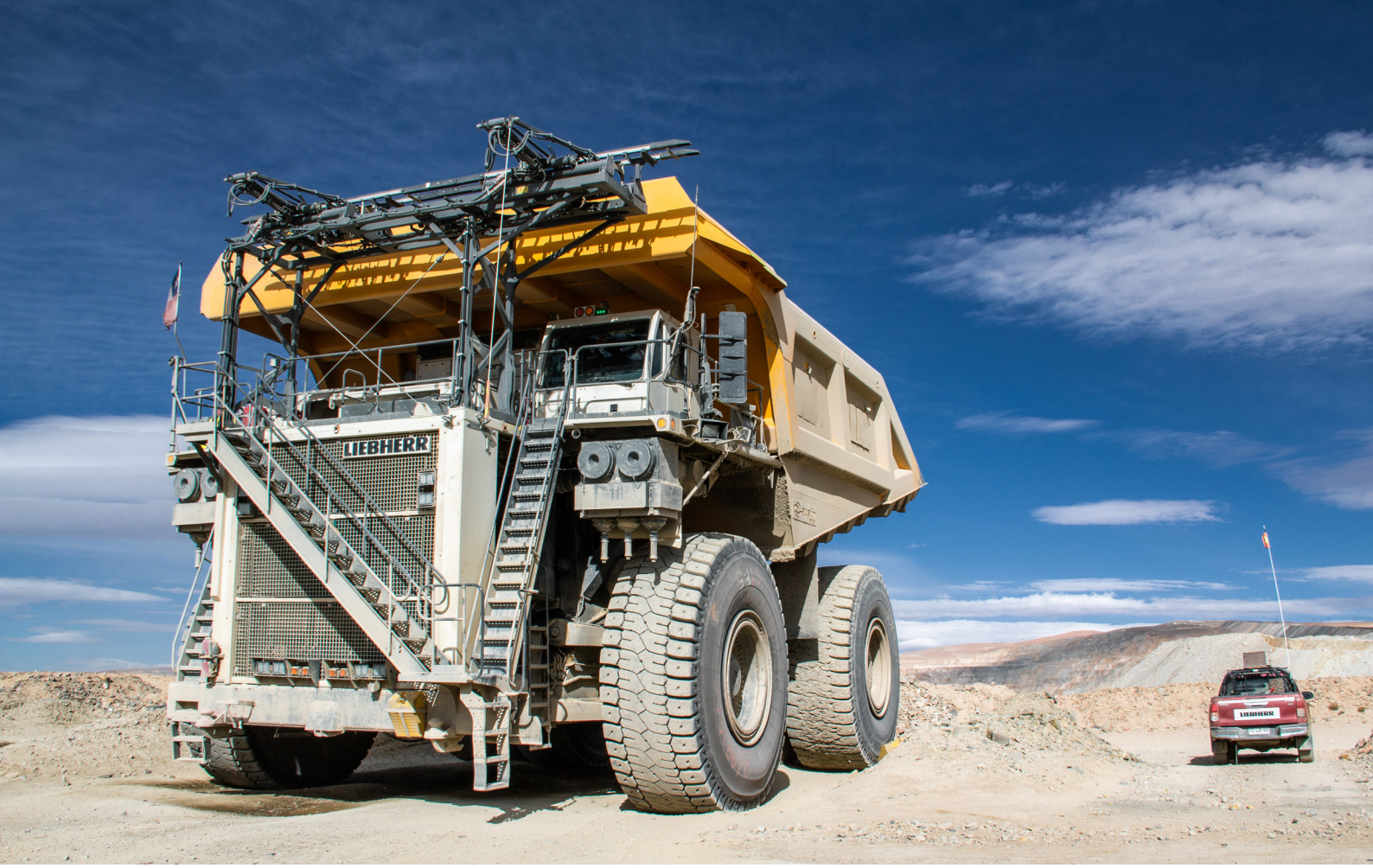
*average CO2e savings over complete haul cycle

Curious about ways to optimise your mine site? Liebherr's application engineering team may be able to help. By running digital simulations, performing observational studies on site and identifying key areas of opportunity, the application engineering team can provide your operations with a competitive edge. If you are interested in learning more, please reach out to your local Liebherr contacts.

Additional benefits

Utilising the trolley line had other benefits for the mine site. There was a decrease in noise while operating under trolley and, in the future, Collahuasi can also expect to see increased engine life due to lower fuel burn and a reduction in average engine load factor.





Conclusion

The installation of the trolley line at Collahuasi has increased the productivity and fuel efficiency of the Liebherr T 284s on site. Each truck equipped with Liebherr trolley technology is expected to move an additional 250,000 tonnes per year.

By electrifying the most energy-intensive segment of the haul cycle, the trolley system delivers faster uphill speeds, reduced fuel consumption and lower emissions – proving that sustainable mining is possible even in the toughest conditions.

Opportunities

Based on the results achieved by the trolley line and the trolley-capable T 284s during the study, Collahuasi committed to adding two additional trolley-equipped T 284s to its fleet in December 2025. The success of this project supports the ongoing partnership between Liebherr and Collahuasi and opens the door for future machine deployments, engine repowers and expanded collaboration.

Liebherr Mining Equipment Newport News
4100 Chesnut Avenue • 23607 Newport News, USA • Phone +01 757 245 5251
info.lme@liebherr.com • www.liebherr.com/mining