

Think & Act Differently

Zero Enty Mining

10th October 2024





Acknowledgement of country

We acknowledge and pay respect to the Traditional Custodians of the land and waterways on which we work from today. We pay respect to Elders past and present and extend that respect to Aboriginal and Torres Strait Islanders people here today.

The world needs the core commodities we produce to support the energy transition...

...and there are global challenges and opportunities to be able to develop these resources in new and innovative ways.

Mines are getting deeper, and lower grade, resulting in more waste and requiring more energy.

Industry-wide cost inflation.

Society's ESG-related expectations are increasing

New deposits are not easy to find

Discovery to production averages 16 years.

**Think & Act
Differently**
Powered by **BHP**

Think & Act Differently's role within BHP is to find and accelerate the best technology solutions to support BHP's ambitions to deliver resources the world needs in new ways.

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We **help innovators mature their technology** to accelerate options to provide resources the world needs.

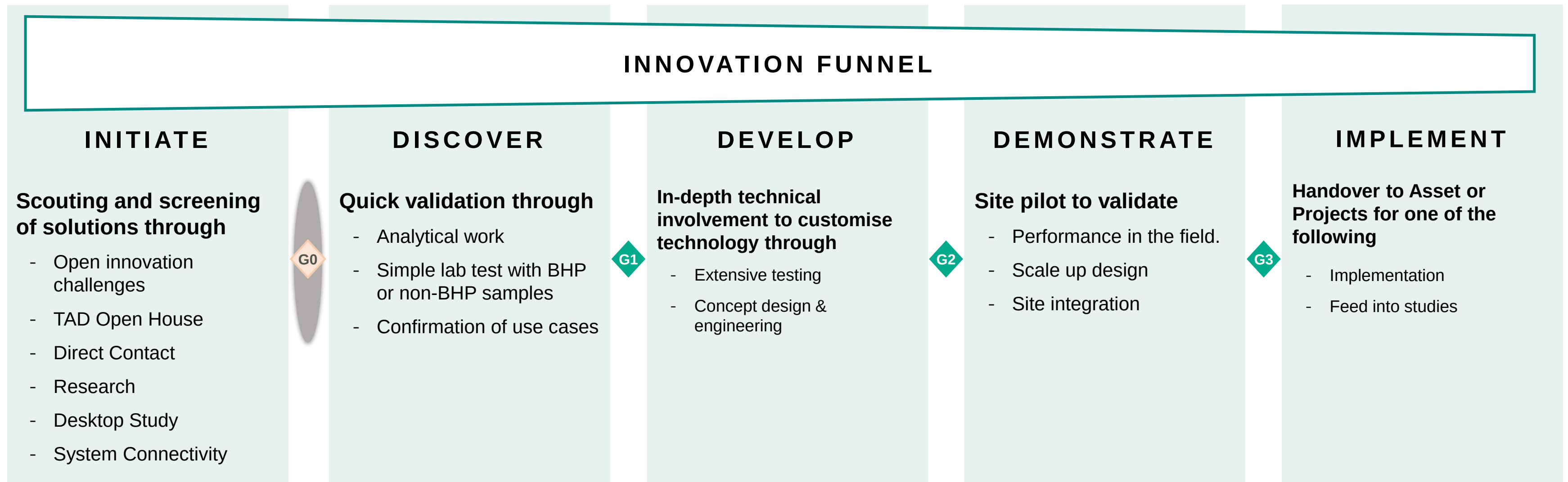


We use a **value chain approach** to fostering a continuous flow of new technologies and capabilities that empower BHP to meet today's needs and build a roadmap for future value.



We use our **superpower, the innovation ecosystem**, to collaborate with a range of individuals and organisations to accelerate technologies at scale, fostering optionality, speed, and diversity.

Our offerings across the innovation funnel help to mature concepts and technologies to produce new options



TAD joint ventures

RioTinto

BOLIDEN

SOUTH32



TAD has established an industry-led collaboration to co-fund trials and demonstrations that gain insight into technologies facilitating lower footprint operations.

Current JV partners include Rio Tinto, Boliden, South 32 and IGO.



Deep Mining Challenge

Can you help unlock the value of deep critical minerals?

Launched: 10th September

Closes: 5th November

Open to; experts, innovators and technologists across any industry that have ideas that can unlock deep mining

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What's the problem?

Deep mining down to 2000m
(1.24miles) or more

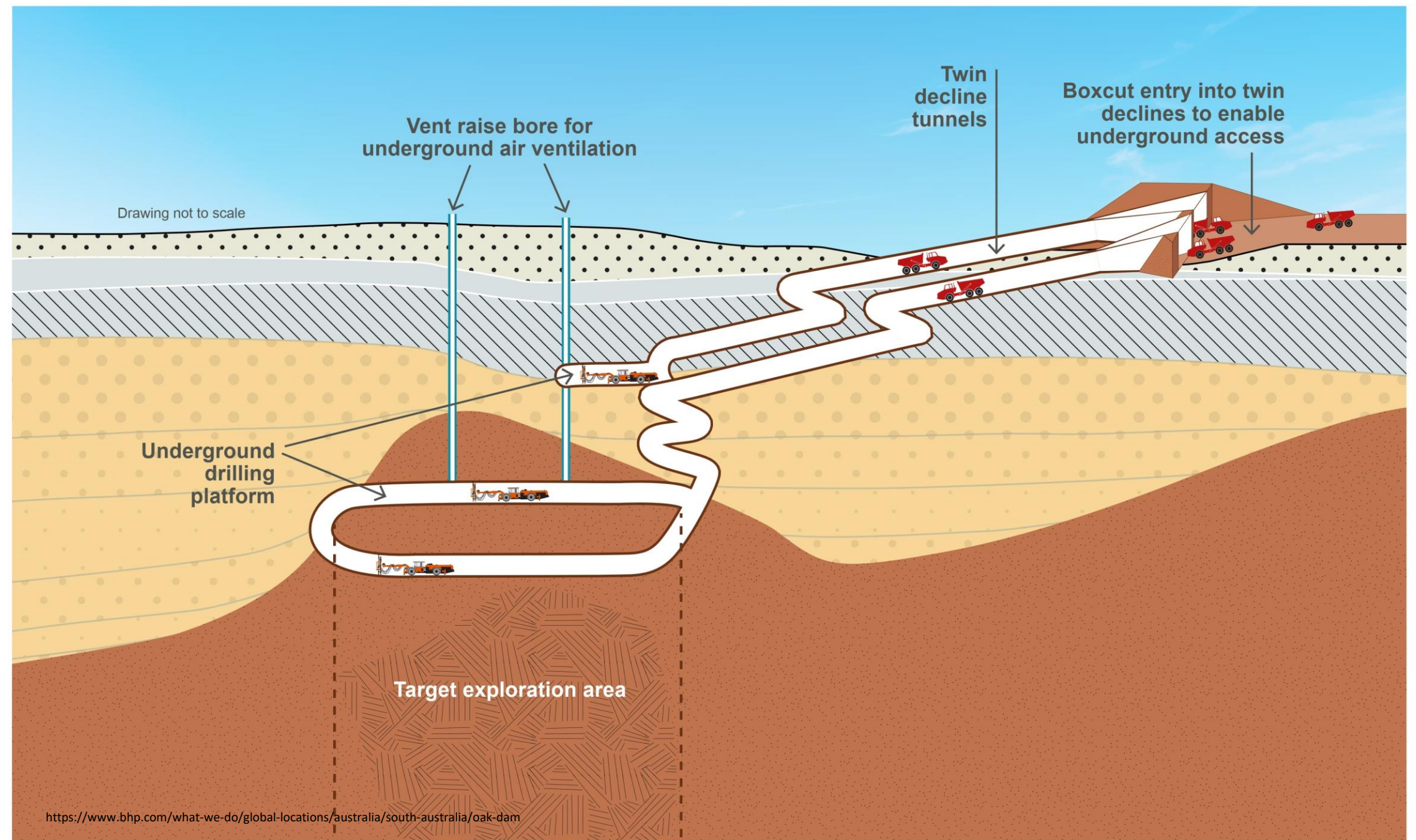
High Horizontal Stresses

High Temperatures

Potential for saline, corrosive
water

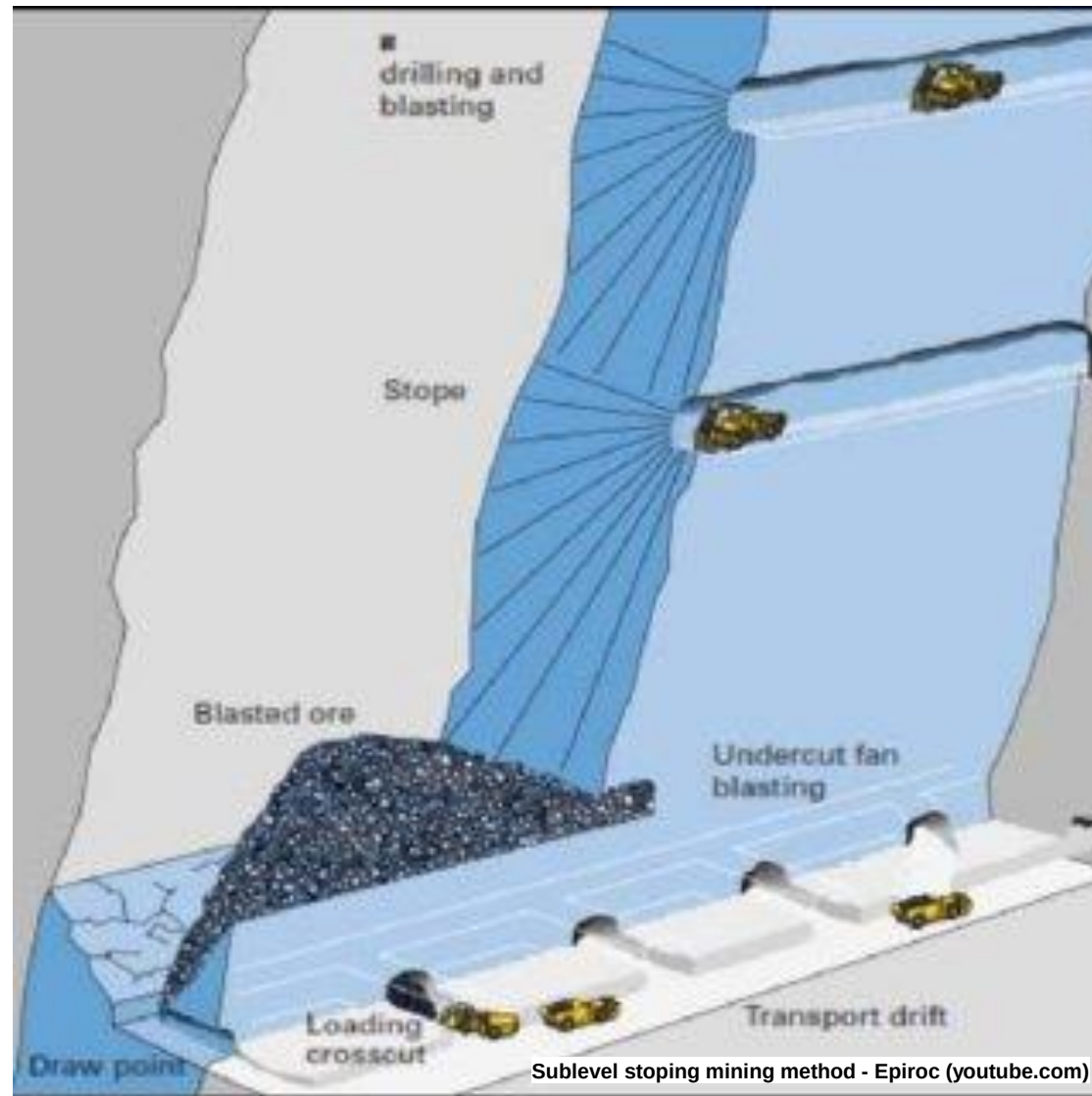
Keep people safe by removing
them from potentially
hazardous excavations

Getting material back to the
surface efficiently

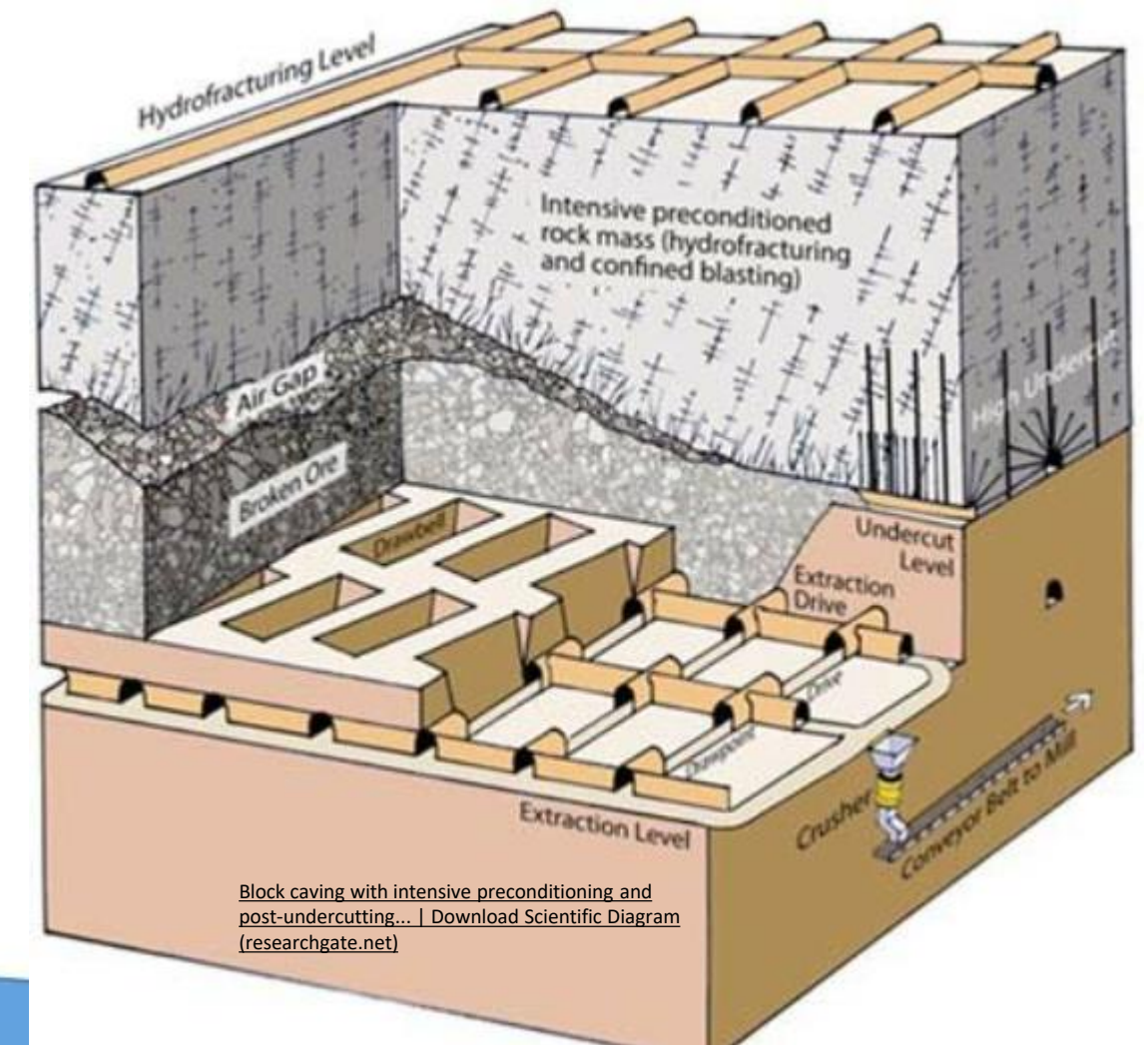
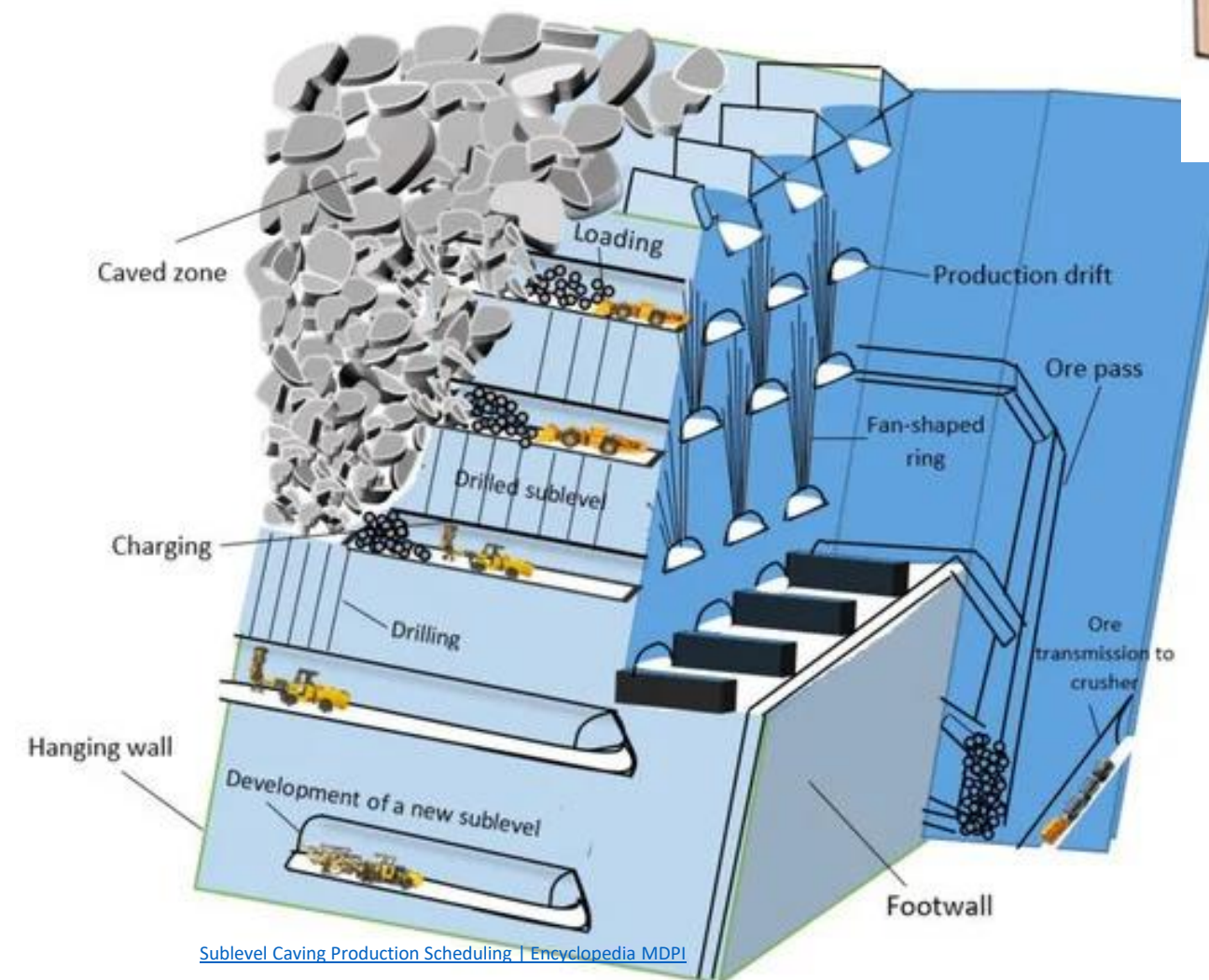


Conventional Mining Methods

Sub Level Open Stopping



Sub Level Caving



Block Caving

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Problem Statements Deep Dive

Excavation and Access to Ore

New excavation methods: Accessing deep ore with current methods is slow and energy intensive. It requires us to move a lot of material, as we need to create space for equipment to excavate and space to extract waste and ore material.

Ore body information and improved support

Geotechnical: The deeper we mine the more information we need to understand how our ore and waste rocks are going to perform. The geotechnical information we have about our ore bodies is usually sparse and low resolution. Supporting the rock is important yet time consuming

Monitoring as we go

Sensors for depth: What drilling methods might enable us to create more stable drillholes that can enable sensors to be used safely? During drilling, we can often control water at depth, but after the fact, any sensors we leave in a drillhole need to be able to survive in hypersaline waters.



Development drilling - <https://anundergroundminer.com/blog/underground-development-mining-versus-production-mining>

Problem Statements Deep Dive



Autonomous operations need remote maintenance and awareness

Situational awareness at depth, survivability of devices, and maintaining operations

How might we build capability that is self-diagnosing, self-repairing and maintained robotically?

How might we deal with replacing key parts such as cutting disks on excavators?

Questions we are trying to answer

How might we accelerate lateral development (tunnelling) to access the resource quicker (baseline is conventional drill and blast), and faster effective ground support installation?

How might we accelerate the drill out of a deep resource?

How might we accelerate the collection of ore body knowledge and generate mineral resource and ore reserve models for decision making quicker ?

What alternate mine methods might we use for a deep resource in a hot, high stress environment (alternate to Sub level stoping and Block Cave)?

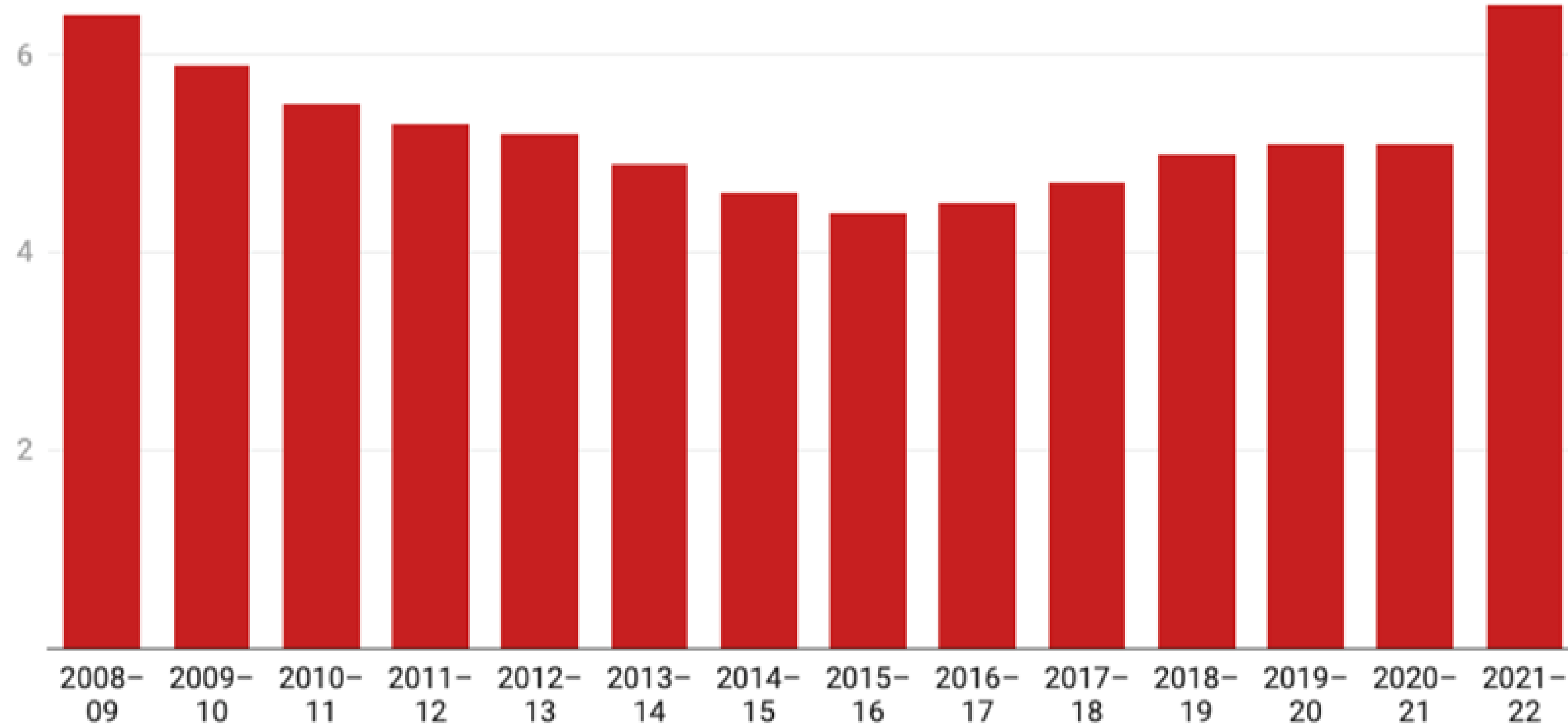
How might we undertake traditional human-based mining related activities in such a mine (eg hanging air and electrical services, servicing equipment, changing pumps, geological mapping and inspections)?

How might we make use of the high temperatures?

How might we prevent corrosion of ground support and equipment?

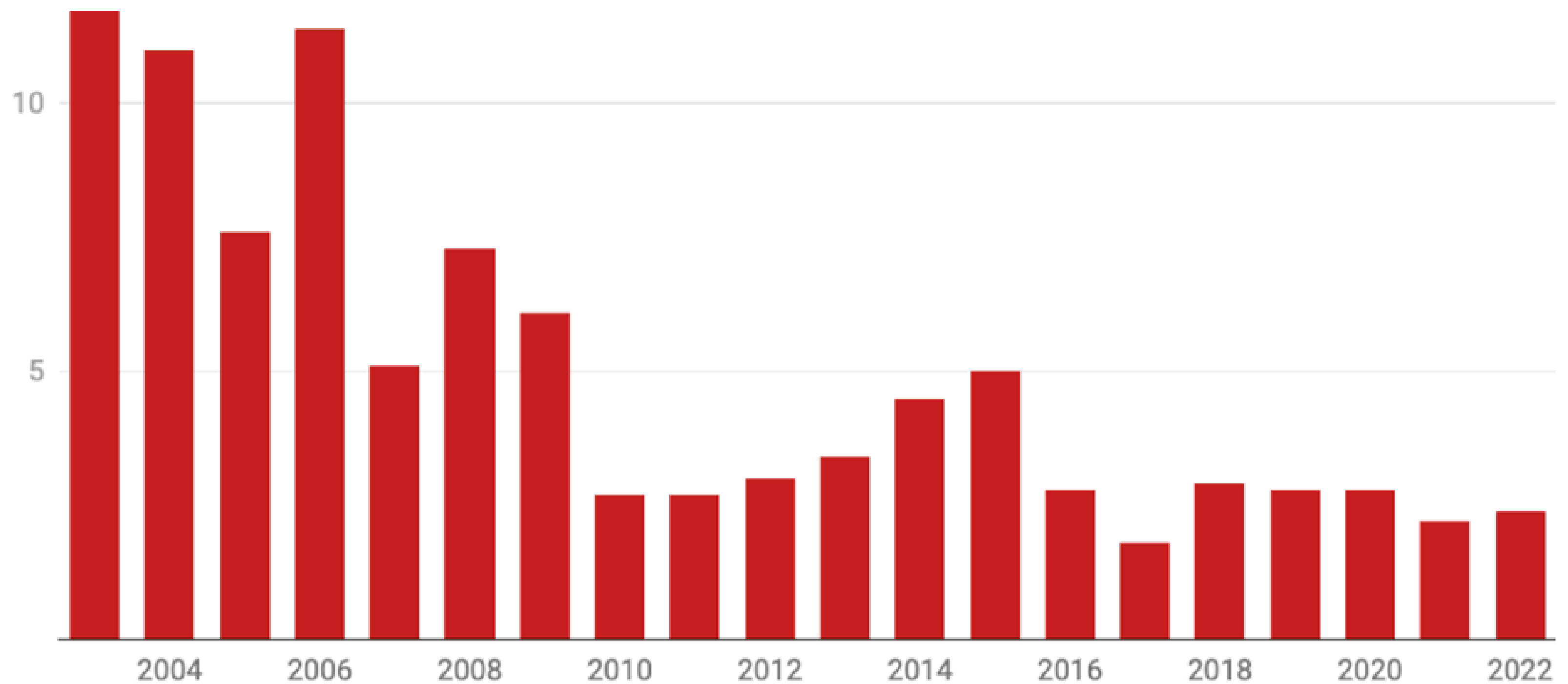
WHY ZERO ENTRY?

Serious injuries in Australian mining



Annual number of serious injury claims to Safe Work Australia per million hours worked.

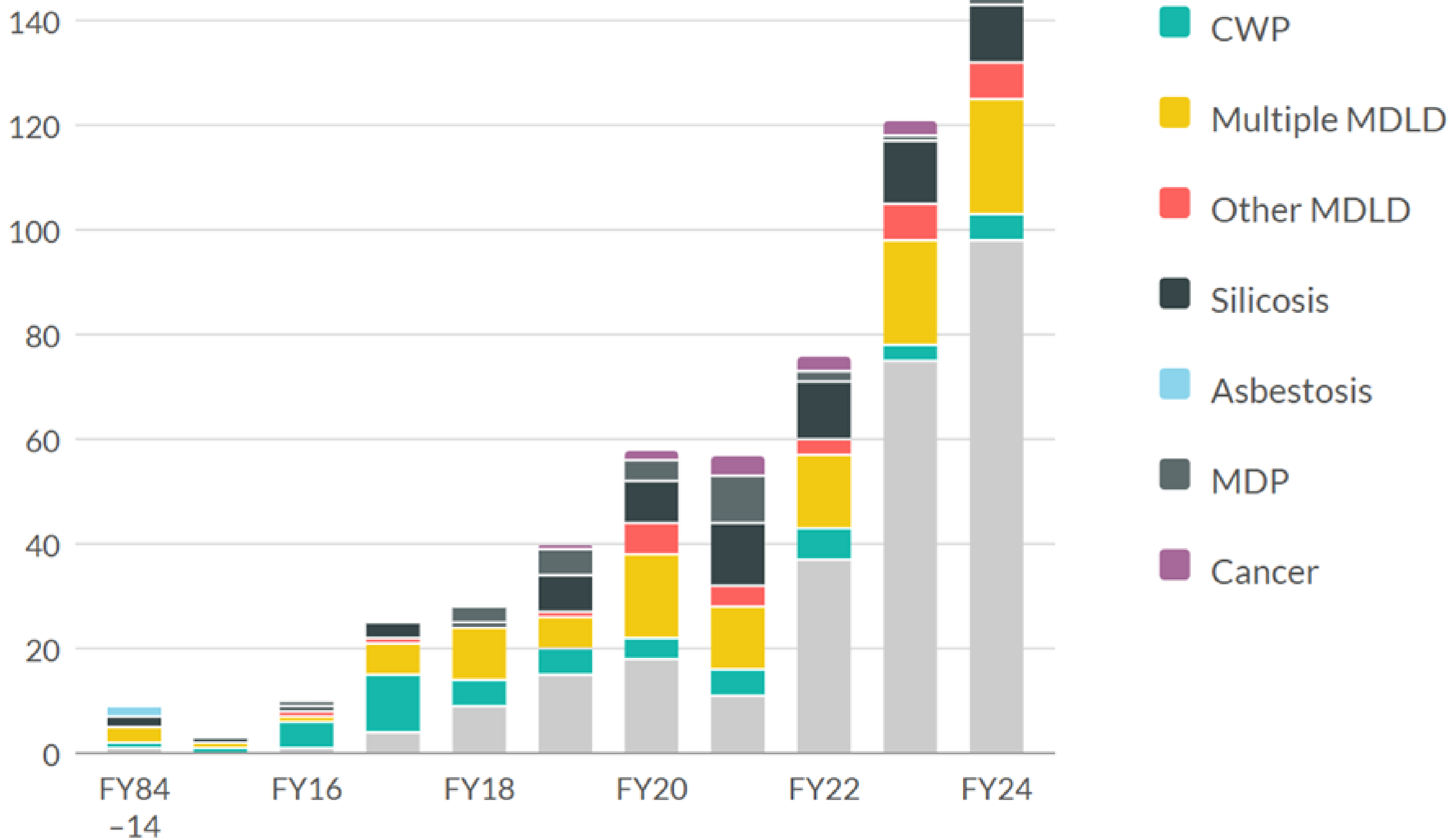
Chart: The Conversation • Source: Safe Work Australia • [Get the data](#) • Created with [Datawrapper](#)



Annual number of fatalities per 100,000 workers in the mining industry.

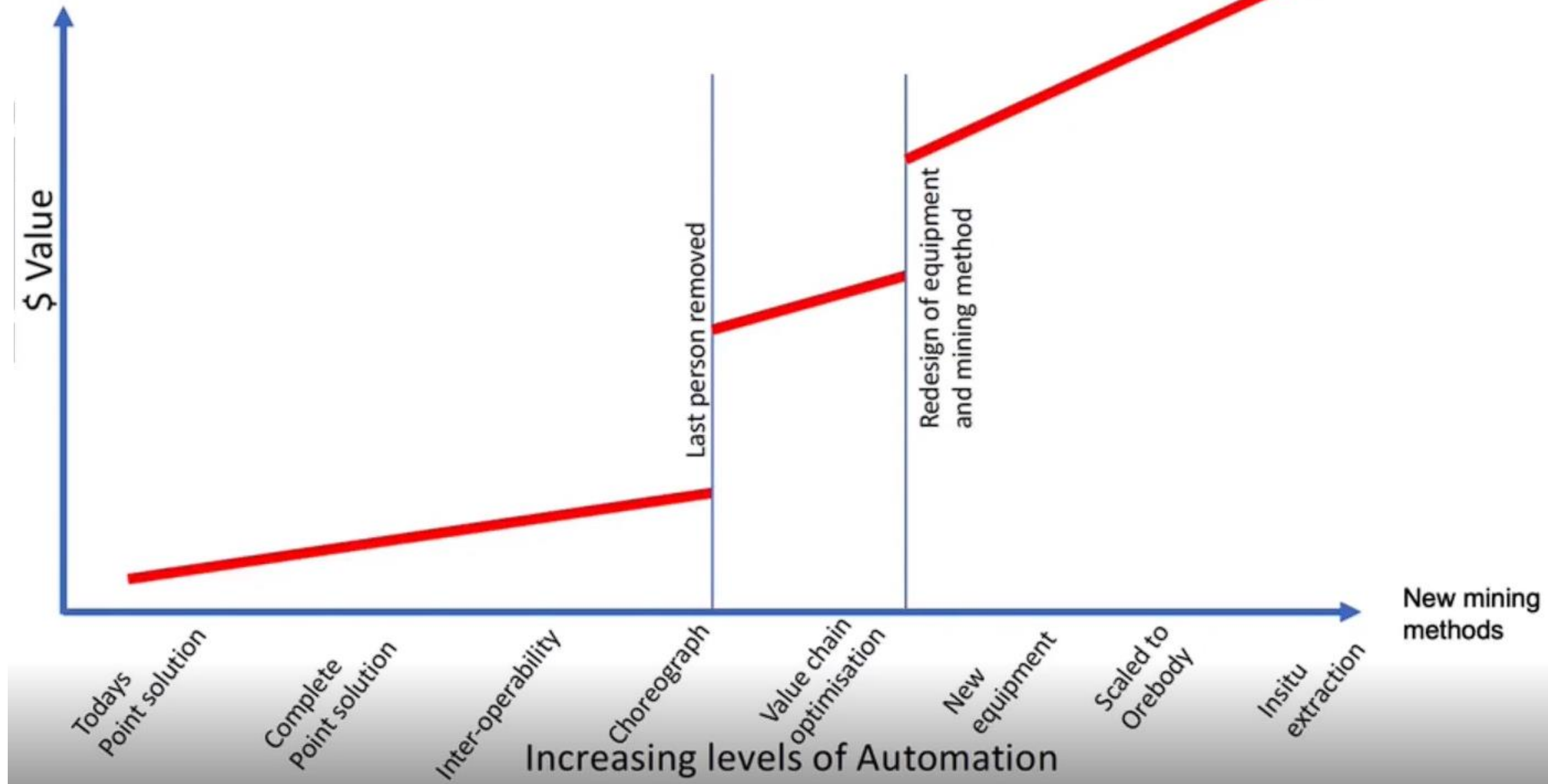
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Number of cases



Financial year

Value of Zero Entry Mining



Zero Entry

No option but to operate remote or automated.

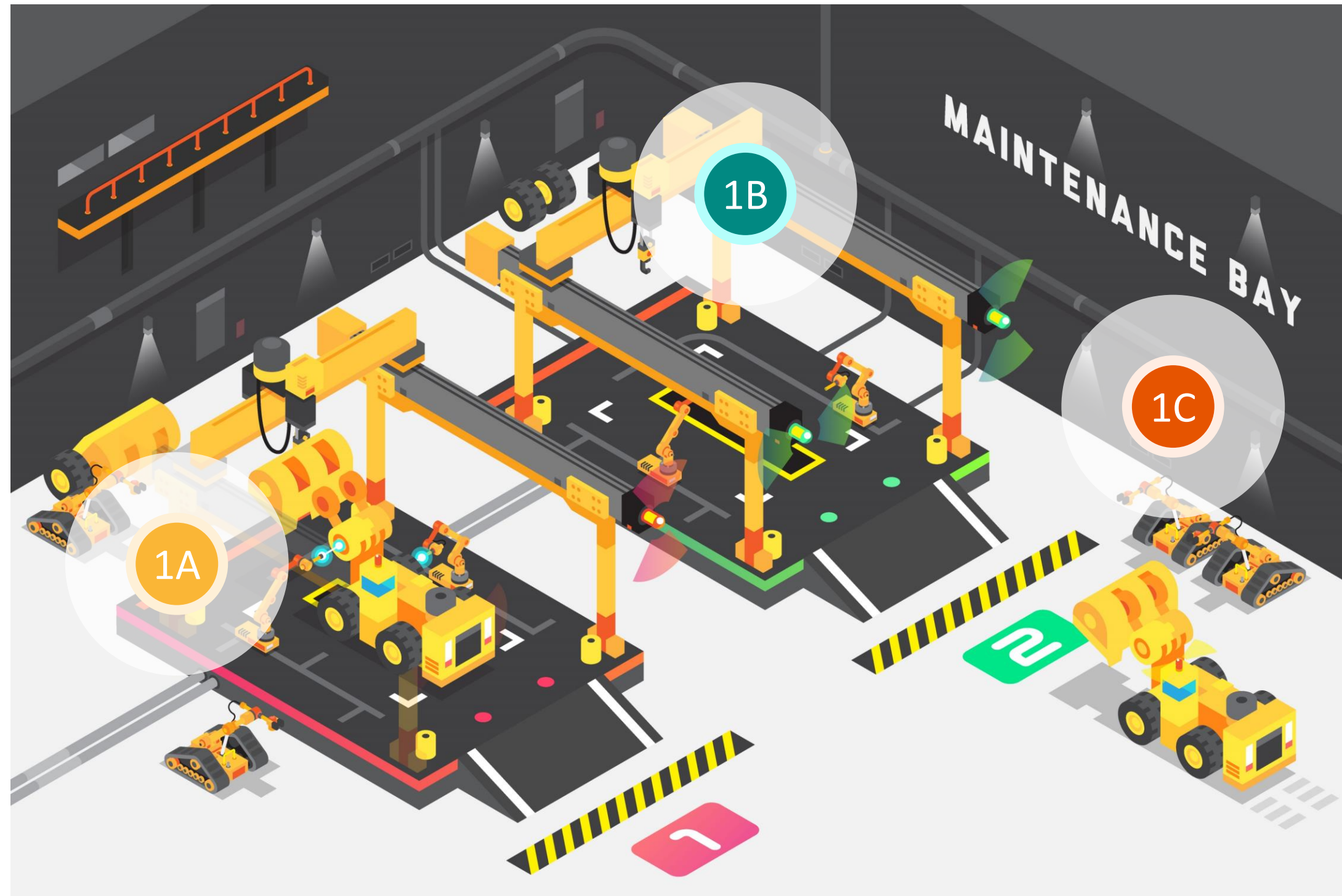
Note: Current model still needs to be loaded by a manually operated loader and is still a prototype



Zero entry Maintenance

Concepts

Potential enabling concepts operate together in a system to realize deep mining operations



Maintenance Concepts

Robotic Maintenance Arms

1A Robotic arms will perform the bulk of scheduled maintenance tasks in the autonomous maintenance bay – the arms are situationally aware and are able to perform tasks requiring a high degree of dexterity

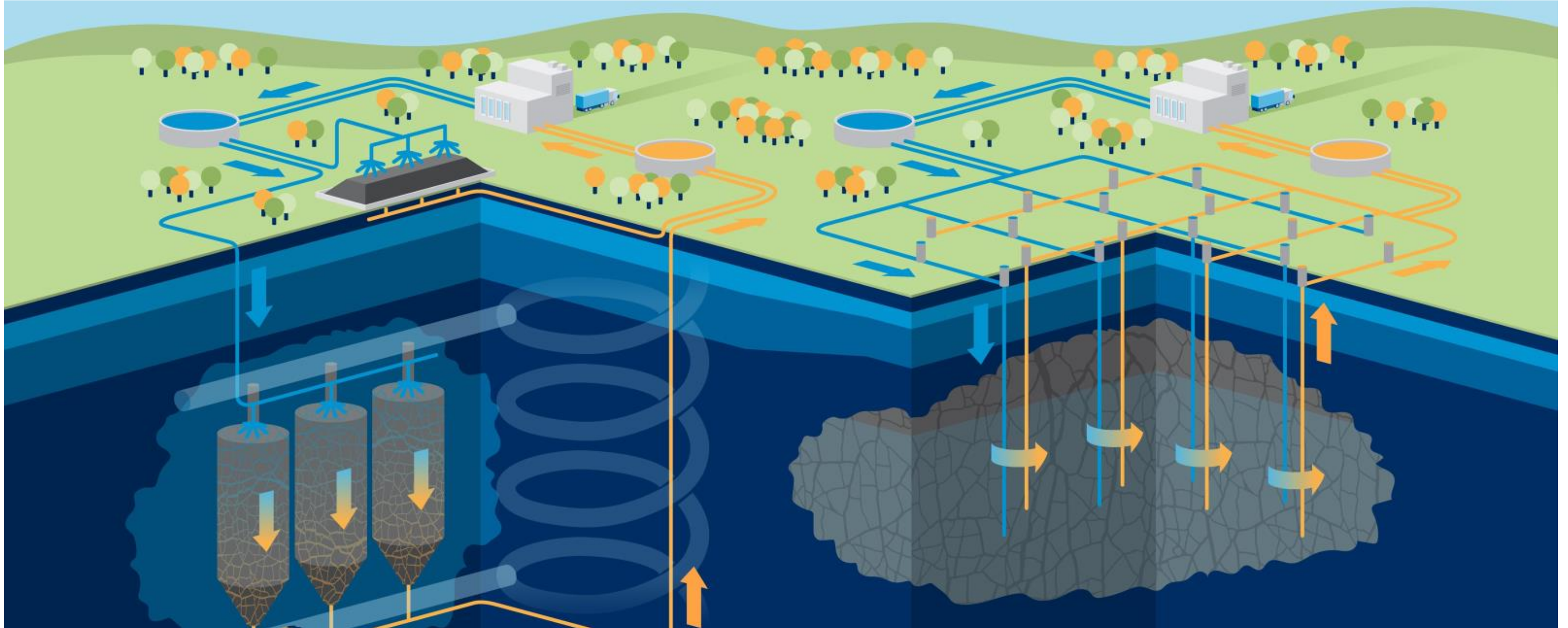
Robotic Gantry

1B The overhead robotic gantries cover the complex tasks involving heavy item / component movement and replacement, these gantries work in conjunction with the robotic maintenance arms

Robotic Maintenance Robots

1C These robots cover the supporting tasks associated with an autonomous maintenance bay, such as mobile troubleshooting or minor mobile maintenance

Zero Entry





ZERO ENTRY MINING PROJECT

What is the impetus to transition mining to zero-entry?
Safety, cost, efficiency, and productivity are all good reasons, but which combination will be the tipping point?



Collaborate with us.

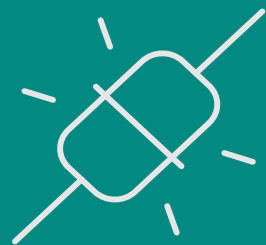
Please get in touch to unlock growth through innovation.

We can create greater value when we work together.

Learn more at Thinkactdifferently.com

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WE ARE A CONNECTOR &
GET TO KNOW THE PEOPLE
BEHIND THE IDEAS



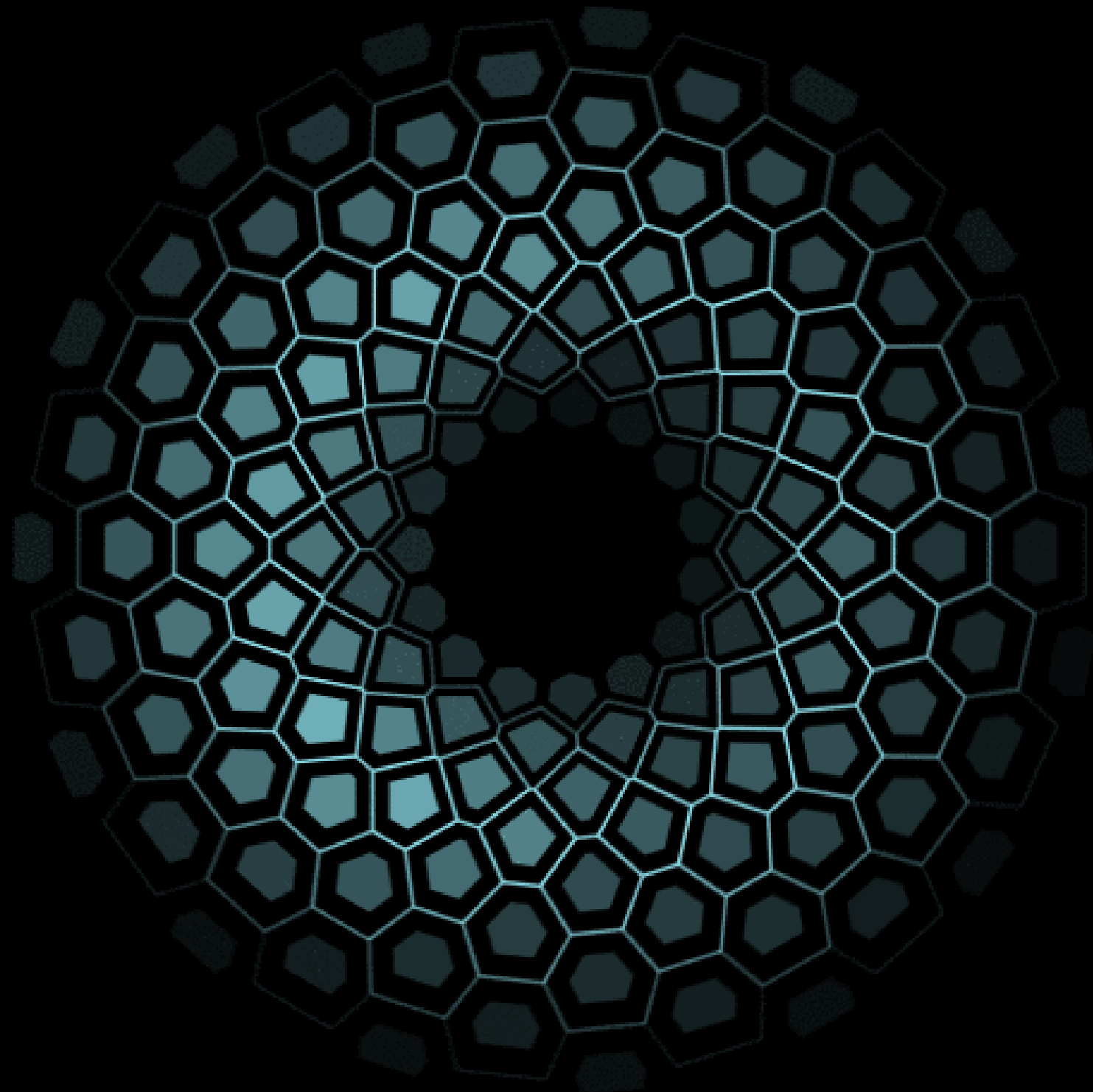
WE ARE AN END-
CUSTOMER & ACTIVE
INVESTOR



WE ARE AN ENABLER &
ACCELERATOR

*“The march of digitalisation, robotics, automation, 3D printing and a plethora of other technological innovation will affect most jobs in some way. But it’s **people**, not technology that will decide the **future of work**. The right decisions will put technology at the service of people with full employment and just transition measures for workers.”*

- Sharan Burrow, Vice-Chair, The B Team



Thank you

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