



Autonomous Systems

- *Example:* Resolute Mining's Syama mine in the Republic of Mali is progressing to be the world's first fully autonomous underground gold mine using, for example, ¹autonomous (i) haulage and loaders (which are used to move/load ore and waste to the surface) and (ii) drilling.
- *Benefits:* Autonomous systems increases worker safety, allow continuous and efficient mine operation 24/7 and up-skill workers to manage autonomous machinery.



Drones

- *Example:* Kumba Iron Ore, a leading South African supplier of seaborne iron ore, uses drone technology, reducing the need for employees to do physical blast clearances; drones are also used to conduct survey technology and general observations.
- *Benefits:* Drones outfitted with cameras and scanners can provide data on operations and current conditions in the mine, increasing worker safety, efficiency and up-skilling workers who manage the drone fleet.



Internet of Things (IoT)

- *Example:* De Beers Marine South Africa (together with Orange Business Services, network-native digital services subsidiary of telecoms giant Orange Group) built an Internet of things (IoT) platform on board the MV Mafuta, currently the world's largest offshore diamond mining vessel, to make sure crew maintain a safe distance from heavy machinery.²
- *Benefits:* A combination of sensors and machinery allows miners to monitor and track operations in real time, increasing safety and efficiency.



AI / Machine Learning

- *Example:* Exxaro Resources Limited, one of South Africa's largest coal and heavy mineral companies, is deploying artificial intelligence (AI), including a first-of-its-kind AI tool for international coal trading.
- *Benefits:* AI/ Machine learning software will enable miners to quickly analyse data and respond to possible business disruptions as well as rapidly identify and address any safety concerns in real time.



Blockchain

- *Example:* Circular announced the first mine-to-manufacturer traceability system of Rwandan tantalum powered by blockchain.
- *Benefits:* Provides traceability and transparency across the supply chain where it is really needed – conflict minerals, rare earth minerals, toxic and polluting waste, child labour-based production, etc.



Hydrogen / Clean Hydrogen / Clean Steel

- Hydrogen is currently produced using natural gas and coal. The recent surge in renewables (solar PV and wind generation) and the resulting decrease in renewable production costs opens the door to producing hydrogen using renewables.
- Hydrogen can replace coking coal in ore-based steel.
- Africa's solar PV comparative advantage over the rest of the world stands African miners in good stead to benefit from the use of clean hydrogen in the mining industry, especially in decarbonising steel making. In particular, South Africa is well poised to take advantage of hydrogen's potential; "with the world increasingly turning towards countries that have optimal renewable energy resources to provide the clean energy of the future, South Africa is in an extraordinary position to revolutionise its own economy and supply green hydrogen to the world."³

1 <https://www.miningmagazine.com/technology-innovation/news/1387604/syama%E2%80%99s-automation-surge>
 2 http://www.connectingafrica.com/document.asp?doc_id=763671
 3 <https://www.pwc.co.za/en/publications/unlocking-south-africas-hydrogen-potential.html>