Figure 1. Vehicle fleets can be connected with the process area, allowing for complete continuity from mine to port.
Much has been written about mine industry digitalisation, electrification and automation, and how new technologies such as artificial intelligence (AI), machine learning, and the Internet of Things (IoT) can help operators maximise production and efficiency, while simultaneously reducing costs and emissions.

ABB’s eMine™ portfolio, for example, is designed to facilitate the transition to the all-electric mines of the future, with fully integrated electrification and automation systems from mine to port. Mine design will integrate these technologies to optimise all processes and equipment – from grinding to hoists, vehicles to conveyors – leading to more efficient, sustainable energy and resource consumption.

Until relatively recently, many mining companies were content to keep automation to a minimum, as long as they continued to hit their production key performance indicators (KPIs). Now, when talking to those working in the industry, the conversation inevitably turns to sustainability and digitalisation; specifically, how electrification and automation can best be deployed to reduce carbon footprint.

In the past, however, electrification and automation were treated as two different disciplines. Now, they are rightly seen as a single entity that, when deployed in partnership with a trusted technology provider, connect the mine to the processing plant for better efficiency along the entire value chain.

This article will discuss this relationship between electrification and automation; how process and power control systems can be connected to manage intermittent power from renewables, for example; and how distributed control systems (DCS), such as ABB Ability™ System 800xA, enable complete visibility and control of every electrical substation throughout the mine site for improved safety and maintenance operations.

**Connectivity and integration**

The ‘2021 State of Play: Electrification’ report from the global management consultancy, VCI, revealed that 98% of survey respondents believe mine automation is the technology that will benefit the most from electrification.

This is both true and encouraging, and a sign that mining is beginning to catch up with industries such as oil and gas and chemicals, both which were early adopters of digitalisation.

Oil and gas and chemical companies have become adept at dealing with challenges around networks, administrating generators, connections, and grid changes – and they have

Mehrzad Ashnagaran and Marcos Hillal, ABB, explain how by connecting electrification and automation solutions in a single, integrated system, companies can extract full value from digitalisation in terms of process efficiency, safety, and sustainability across the entire mine value chain – from pit to port.
done so by connecting electrical and automation systems and teams together to visualise operations in a broader way.

By expanding System 800xA from the processing plant to the mine itself – and integrating both into a single platform – ABB is able to connect haul truck trolley systems to the same automated platform that runs the mine. At the same time, the DCS is designed to be an open-standard solution, meaning the mine electrification system can be connected and transfer data to non-ABB systems.

This vendor-agnostic approach also applies to ABB’s pilot eMine FastCharge, set to be the fastest and only fully automated charging system for mining haul trucks offering up to 600 kW of power.2

By following open automotive/industrial standards and targeting a battery electric vehicle (BEV) original equipment manufacturer (OEM) agnostic approach that offers maximum flexibility when it comes to vehicle charging, eMine FastCharge allows underground and openpit projects to seamlessly integrate charging of haul trucks into their work order schedule, minimising infrastructure expenditure and maximising the return on investment for mine operators.

Connecting electrification and automation systems is no longer a ‘nice to have’. Without this type of integrated control system, operators cannot gather data on systems such as trolley lines for electric trucks effectively – what is the status of each vehicle, for example, or why is truck A consuming more power than truck B with the same payload? Using tools like System 800xA, connected to energy management systems (EMS) systems and mine operations systems, production schedules and cycle times can be formulated in an optimal way so that mines extract full value from the technology.

Leveraging learnings from digitalisation

As mentioned earlier, the mining sector is in a relatively early stage in its digitalisation journey, which means that many of the benefits to be had from connecting and integrating electrification and automation systems are yet to be realised. Knowledge and insights from data extracted from day-to-day operations can only come with time spent monitoring and running vehicle fleets, for example.

ABB’s involvement with the Copper Mountain project in British Columbia, Canada, is a case in point.3 Combining ABB’s electrification and automation expertise, the installation includes engineering, supply, and construction management for a DC substation and overhead catenary system (OCS).

The company reported that the haul truck trolley assist infrastructure has cut carbon emissions by 90% on the trolley segment, contributing to Copper Mountain’s final target of zero emissions by 2035.

Customers say they want more data, more connectivity and integration of production planning, short interval control, and fleet management systems to enable them to make more informed decisions that improve throughput, reduce emissions, and add real business value.

The power to succeed

Mines are becoming increasingly energy-intensive; 60 – 70 MW operations are now the norm rather than the exception – while at the same time being located far from infrastructure and grid systems.

The traditional centralised power generation model provides constant and reliable power matched to demand profiles that are well understood, balancing production and demand and stabilising the power grid to avoid frequency fluctuations.4 Renewables, such as wind and solar, disrupt this pattern, so identifying the supply needs of the project – ideally at the design stage – is of critical importance.

Questions mine operators should be asking include:

- Is the external grid robust enough to transfer sufficient quantities of continuous power – i.e. 24/7/365?
- Can the network cope with fluctuations caused by renewables?
- Has the mine’s internal power network been modelled with these specific operational demands – everything from hoisting and grinding to hauling and material handling – front of mind?

Electrification, automation, and digital solutions that integrate renewables with power management and storage systems to provide stable power distribution and decarbonise operations are important, of course, but so is power quality. That is why, in addition to trolley line and rapid-charging systems, ABB also provides solutions like active dynamic voltage reactors, power factor correction capacitors and static VAR compensators, combined with digital and automated control and monitoring applications.
Together, this portfolio of solutions helps mitigate the potential impact of intermittent power supply – costly production downtime from blackouts and short circuits, for instance – and maximise profit.4

Towards fully automated, all-electric mines
So, to the future. It is feasible that one day mines will be run using AI. By deploying automation and electrification solutions now, companies such as ABB are paving the way for the next evolution in mining. The company would go even further and say that this future transition from more simple PLC/SCADA (island operated plants) systems to all-electric, fully automated mines cannot happen until existing automation and digital systems are fully integrated – supported by the transformation of mine processes and workforces.

Underpinning all this is the fact that decarbonising mines not only requires the latest power quality and digitalisation technologies, but also a fresh approach to the provision of power; one that relies on a holistic view of the entire mine energy ecosystem, and that is connected and fully integrated.4

Technology vendors, such as ABB, are evolving too. In greenfield projects in particular, the company now adopts more of a power management role, whereby it not only provides mining customers with reliable grid connection, but rather a total integrated electrification solution encompassing power behaviour modelling, recessionary energy storage, and micro-grid concepts independent from the main grid.4

For many years, ABB has helped mining companies manage power usage using the company’s systems and services. This will continue, but now there is an evolution towards solutions such as ABB eMine, where complete power management is associated with automation and digital solutions, creating a complete ecosystem for the entire power generation at the mine, including the integration of renewables and off-grid storage.4

Conclusion
In conclusion, then, automation and electrification should not be viewed in isolation; instead, they should be linked and embedded together at mines, so that the vehicle fleet is connected with the process area. This allows for complete continuity from mine to port, facilitating innovations such as remote monitoring and predictive maintenance, and, eventually, the fully autonomous mine of the future.  

References