

Date: September 11<sup>th</sup>, 2025



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# Planning and Implementation of an Electrified Fleet

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## Safety Share

“BEVs make mines cleaner and quieter, but safety doesn’t stop at removing diesel. Adapting training, procedures, and emergency preparedness to suit BEV technology is essential for safe, reliable operations.”





# Mayhew Performance LTD (MPL)

- **Innovation & Technology** – Driving cutting-edge solutions to transform mining operations.
- **BEV Implementation & Automation** – Pioneering battery-electric vehicle integration for sustainable mining.
- **Operational Readiness & Execution** – Ensuring seamless project delivery from concept to production.
- **Mine Due Diligence** – Providing expert analysis for informed investment and operational decisions.



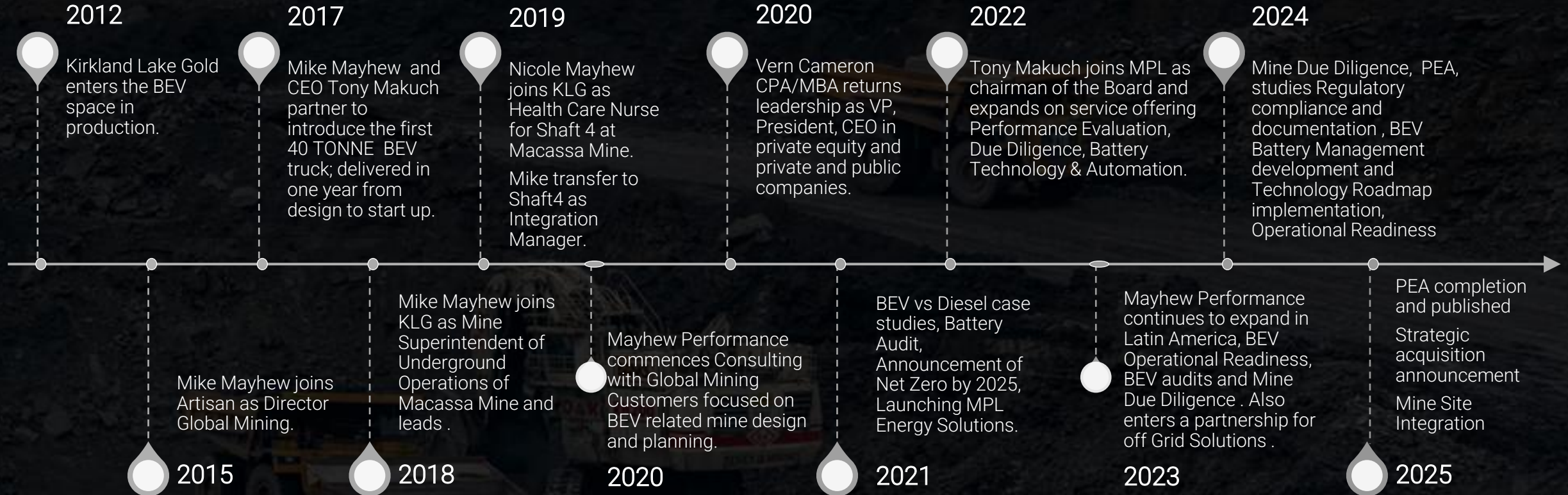
# Background

- 2012 – Kirkland Lake Gold enters the Battery Electric Vehicle (BEV)
- 2015 – Mike Mayhew joins Artisan as Director, Global Mining.
- 2017 – Mike Mayhew, Artisan, and CEO Tony Makuch partner to introduce the world's first 40-tonne BEV truck, delivered in just one year from design to start-up.
- 2018 – Mike Mayhew joins Kirkland Lake Gold (KLG) as Mine Superintendent – Underground Mine Operations at Macassa Mine, responsible for BEV equipment.
- 2019 – Mike appointed Integration Manager for the Shaft 4 Project.
- 2020 – Mayhew Performance Ltd. begins consulting with global mining customers, focusing on BEV-related mine design, planning, and implementation.
- 2020-Ongoing – MPL is recognized as the subject matter expert around the world for BEV implementation and mine Due Diligence.





# MPL Journey



# Mayhew Performance Clients

Discoverysilver



GLENCORE



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# Global Projects

We are committed to making the world a better place. We are a Canadian company reaching out to the world. We provide technical expertise around the world.





# Introduction

- Electrification in mining is a critical step towards sustainability.
- Battery Electric Vehicles (BEVs) reduce greenhouse gas emissions, noise, and heat generation underground.
- Case study outlines proven methods for BEV adoption in mining.
- Applicable to greenfield and brownfield operations.







## Step 1: Strategic Assessment

- Review current operational performance and fleet composition.
- Identify potential applications for BEVs based on duty cycles and haul profiles.
- Align BEV adoption strategy with corporate ESG goals and regulatory requirements.
- Conduct cost-benefit analysis comparing BEVs and diesel equipment.





## Step 2: Technology & Vendor Selection

- Evaluate available OEM BEV offerings for mining applications.
- Consider payload capacity, charging speed, battery life, and compatibility with mine layout.
- Run demonstrations and trials with shortlisted OEMs.
- Assess vendor training programs, aftersales service, and spare parts availability.





## Step 3: Infrastructure Planning

- Plan electrical upgrades to support charging infrastructure.
- Integrate renewable energy sources to reduce carbon footprint.
- Redesign ventilation systems to optimize airflow due to reduced diesel emissions.
- Implement charging station safety protocols and redundancy systems.





## Step 4: Pilot Program Implementation

- Select representative operational areas for pilot BEV deployment.
- Establish performance KPIs: cycle times, energy use, downtime, and maintenance frequency.
- Gather operator feedback to refine procedures.
- Use pilot data to support full-scale deployment decisions.





## Step 5: Training & Change Management

- Develop comprehensive operator and maintenance training tailored to BEVs.
- Educate workforce on new safety measures and emergency protocols.
- Encourage cultural acceptance of technology change.
- Appoint transition champions to maintain momentum.







## Step 6: Continuous Improvement

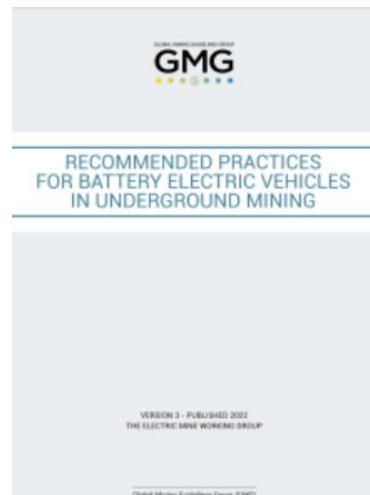
- Adopt predictive maintenance practices using IoT and telematics.
- Benchmark performance against industry leaders and peer mines.
- Evaluate new BEV models and battery advancements regularly.
- Enhance sustainability by integrating additional renewable energy solutions.





# MPL Audit Report

The intended outcome was to identify the gaps and provide guidance and recommendations to the BEV Operational Team.



Audit framework was developed with reference to GMG guidelines

Mayhew Performance Ltd. Audit Legend		
	Non-Compliant	No proof of documentation during BEV Audit
	Partially Compliant	Work in progress but not completed during BEV Audit
	Compliant	Compliant and meets BEV Audit Requirement

Category			
Health & Safety			
Mine Rescue and Emergency Response			
Risk Management			
Operations			
Maintenance			
Facilities			
Infrastructure			
Logistics & Transportation			
Training			
Performance			
Total Answers			



# Risk and Safety Management

Responsibility	Accountability	Supportive	Consulted	Informed
Who is Responsible? And what are their responsibilities?	Who is Accountable and what are their responsibilities?	Who supports them? What are the supportive actions?	Who can provide valuable advice or consultation for the task?	Who is notified about progress and decisions?
R	A	S	C	I

Responsibility	Accountability	Supportive	Consulted	Informed
Control Group-Upper Management Make all calls as per legislation Initiate response protocol	Control Group Co-ordinate and direct Emergency Response	Mine Rescue MRO's Help co-ordinate emergency response	Mayhew Performance OEM's Head Office	MOL Mine Rescue Office
R	A	S	C	I



# Battery Management

## FIRE SAFETY

- Root causes of published incidents:
  - Thermal runaway due to battery isolation fault (coolant leak)
  - Non-OEM replaced fuses
  - Battery arcing due to isolation issue and transportation

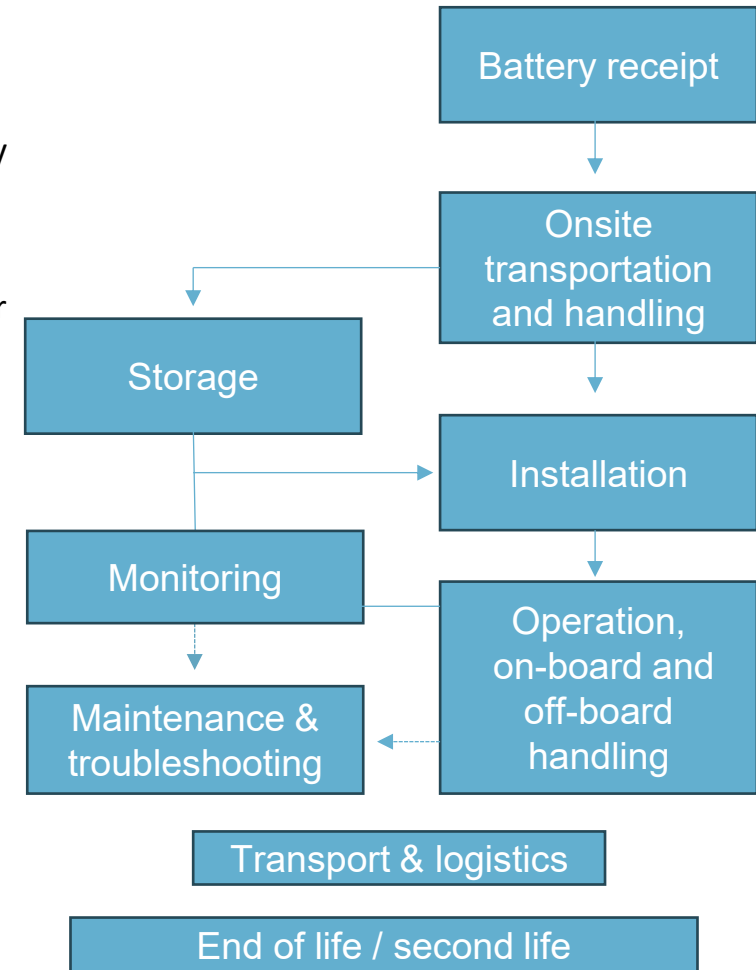
## What do they have in common?

- Preventable, if actions and measures are in place for transportation and handling.
- Monitoring, awareness, and auditing can minimize risk.

## STORAGE

- Follow OEM recommendations (e.g., temperature requirements, humidity requirements)
- Every site will be different – consider warehousing, containers, environmental conditions

**Overall goal:** Site owns the process and is accountable for the execution of BEV implementation





# Essential Key Steps for BEV Integration

- Conduct site readiness and operational assessment
- Define technical and performance requirements
- Engage with OEMs and technology partners
- Plan infrastructure and charging systems
- Implement pilot testing programs and stakeholder engagement
- Train operators, maintenance and management teams
- Monitor, evaluate, and scale implementation







# Some Key Take aways

- Electrical Hazards – High-voltage systems require certified technicians, arc-rated PPE.
- Battery Thermal Runaway – Monitor temperatures, install fire suppression, have Class D extinguishers.
- Charging Station Safety – Inspect cables, use cable management, follow OEM protocols.
- Emergency Response – Train workers on BEV shutdown, update mine rescue procedures, run drills.
- Ventilation Changes – Review airflow and gas monitoring even after diesel removal.
- Takeaway: BEVs improve conditions, but safety protocols must adapt to new technology.





## Conclusion

- BEV adoption transforms mining operations towards a low-carbon future.
- A structured roadmap ensures operational, financial, and ESG benefits.
- Lessons from global projects provide a replicable framework and working with GMG sharing best practices
- Continuous improvement is key to maximizing ROI and sustainability outcomes.



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