



Application of Alternative Power Sources in Noise Risk Management

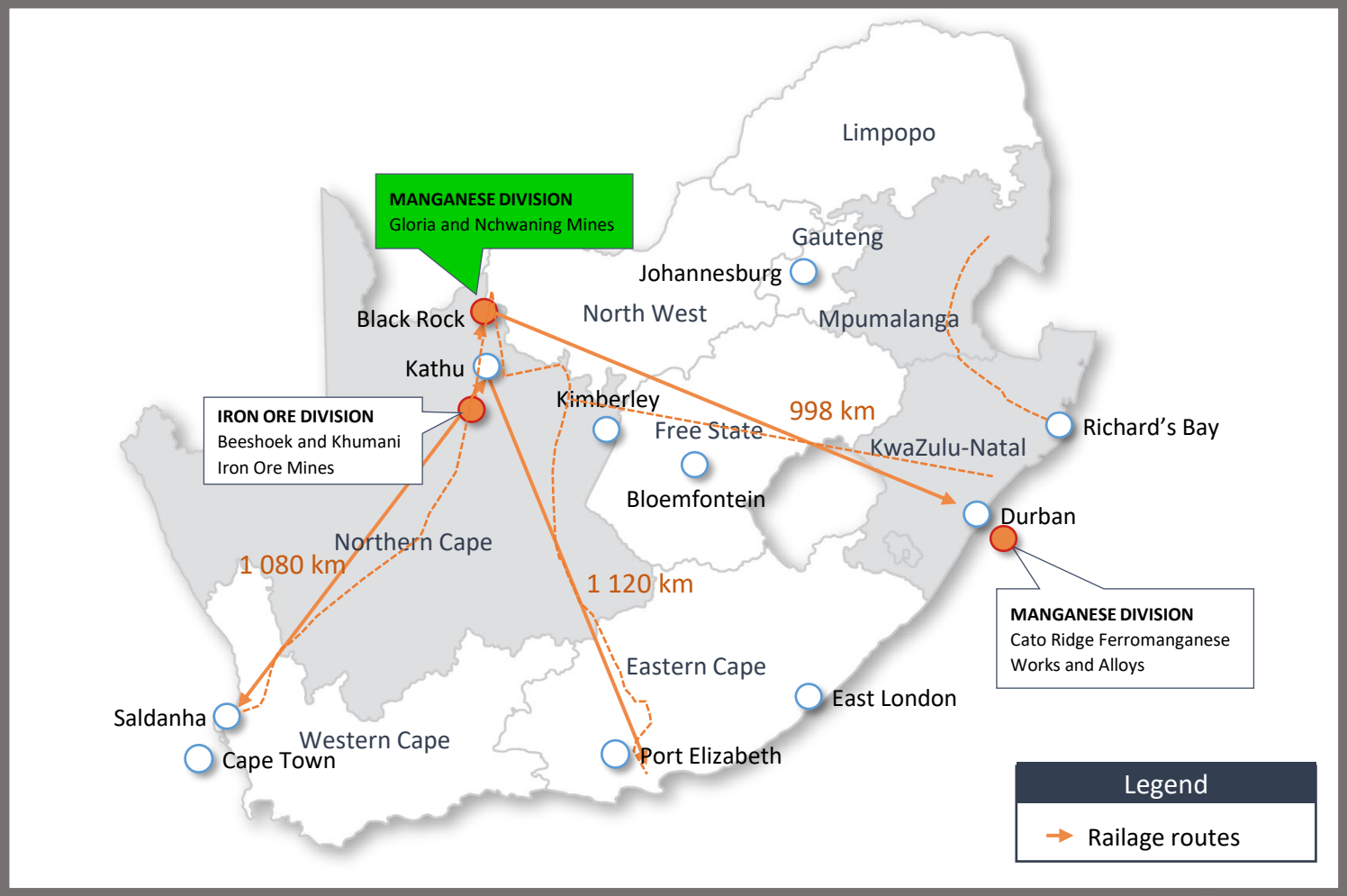


ASSMANG OPERATIONS AND LOCALITY

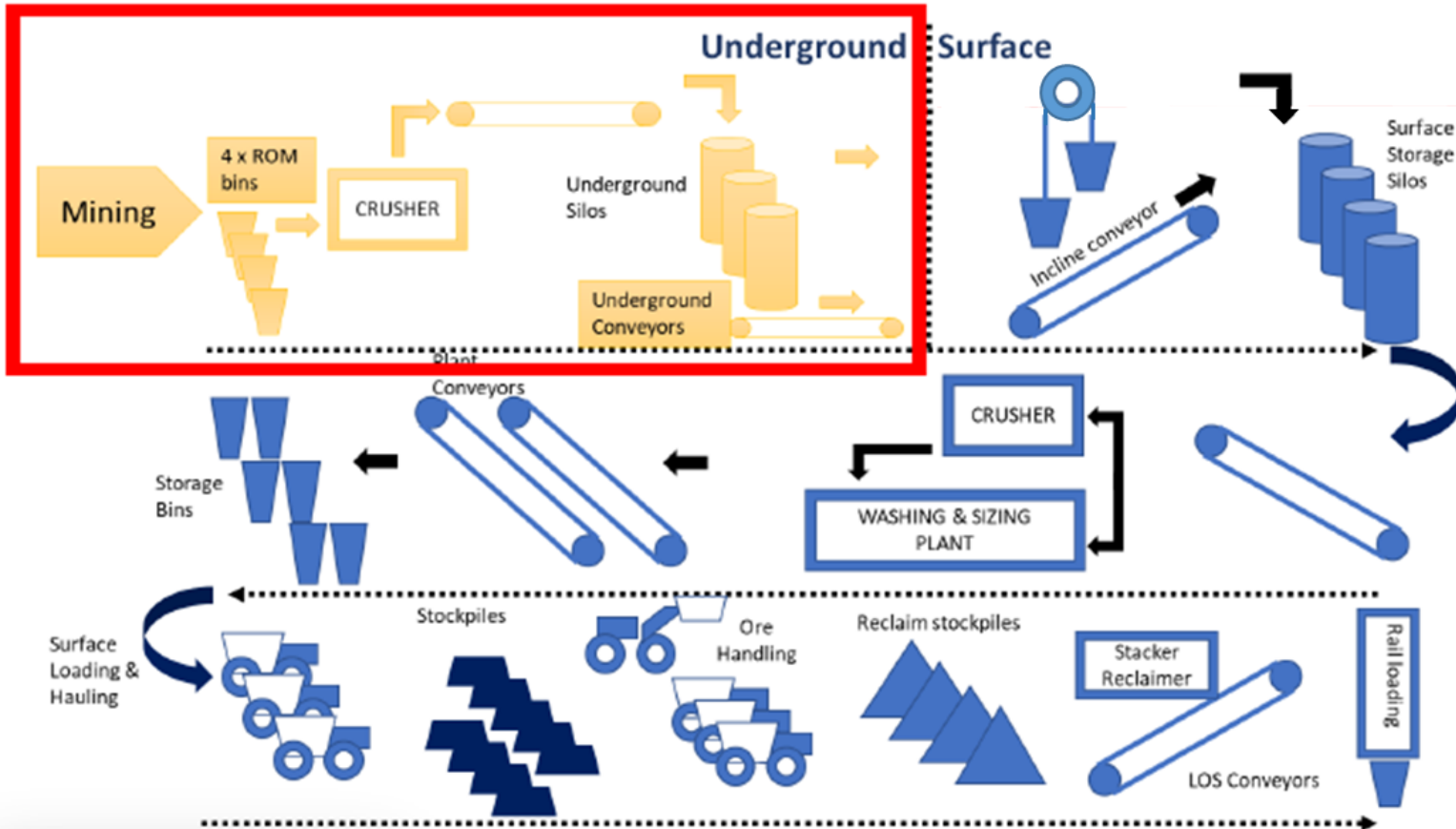


Blackrock Mine Operations Overview

- Permanent Employees **2400**, Contractors **1200**
- Three underground shafts:
 - Nchwaning 2 & 3 and Gloria
- Ore Reserves for Nchwaning and Gloria Mines is **226Mt**
- Life of Mine is **42 years** (Nchw & Gloria)
- Fully mechanized operation – bord & pillar mining method



OVERVIEW – NATURE OF THE BUSINESS



Hoisting

- Incline Conveyor
- Rock Winder

Surface Storage Silos

- High Grade
- Low Grade

Crushing, Washing & Screening

- Secondary Crushing
- Washing and sizing according to requirements
- Split into Lumpy and Fines

Stockpiles

- 400 –800t Stacks
- With Front End Loaders and Haul Trucks

Stacking Reclaiming & Load-out

- Stackers & Reclaimer
- Rapid Load-out of trains for Transnet

KEY TECHNOLOGY TO SUPPORT BRMO VISION

Plant Optimisation

Geoscans, AI Cameras, Crusher & Screen Optimisation



SOT Optimisation

Dispatch and Material & Grade Tracking



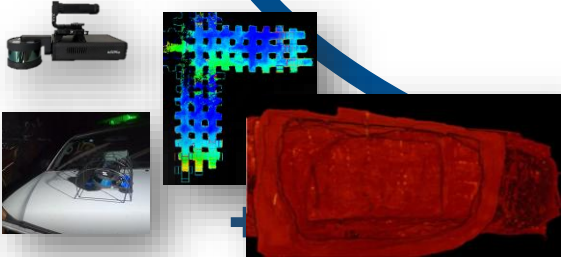
Stock Yard & Load out

Reclaimer Capacity 3500 t/h



Optimise Mining Geometries

Lidar SLAM scanning – 24hr turnaround
(Advance, Height, Width)



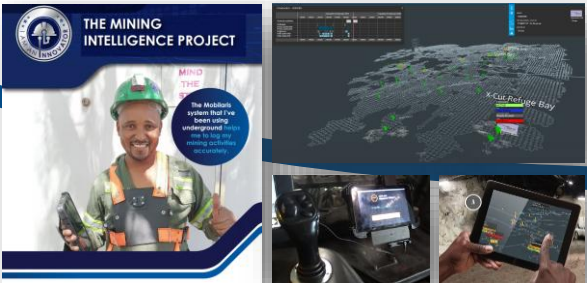
Integrated Training

Utilising latest customised VR and Simulator training aides -



Mining Intelligence

(UG Wi-Fi, Mobilaris System, Smart Enabling TMM's, Tablets, Tracking tags)

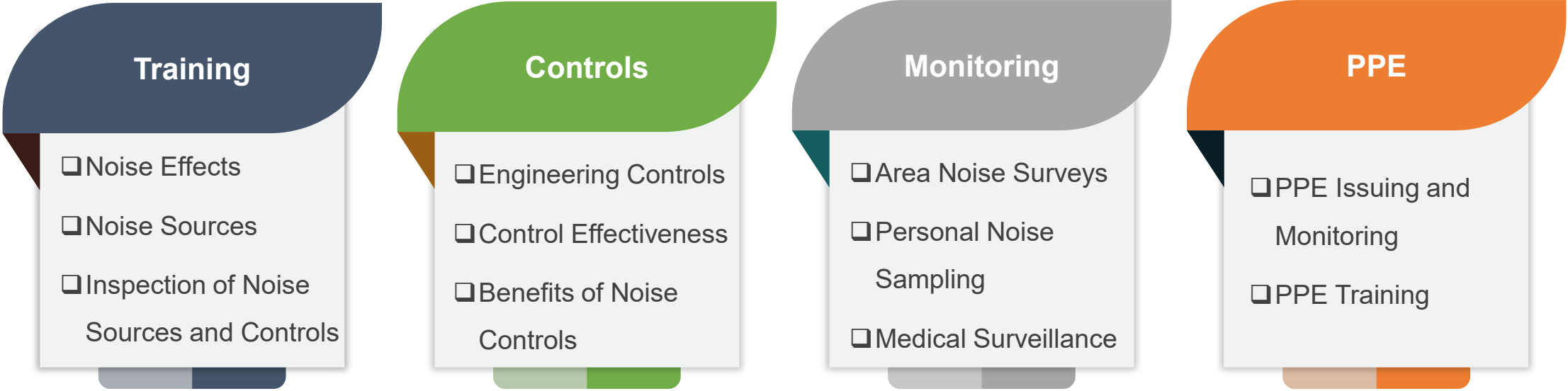


Intelligent Machines

BEV's, S2's, Smart Enabling TMM's (CPS, Telemetry)



BRMO: NOISE RISK MANAGEMENT



BRMO: BEV IMPLEMENTATION STRATEGIC OBJECTIVES



Decarbonization (Baseline 2023)

1. Reduce 15% by 2026
2. Reduce 30% by 2030
3. Achieve Net-Zero 2050



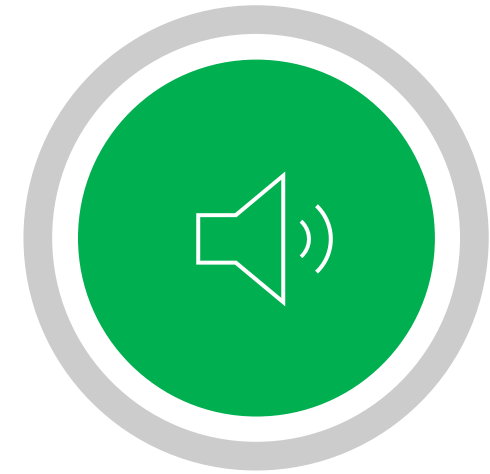
Ventilation Cost Reduction

1. Reduce the number of main fans running
2. Reduction Trading off an additional raise borehole
3. Reduction of face quantity requirement.



DPM Reduction Strategy

1. Reduction of DPM Exposure



Unintended Positive Outcome

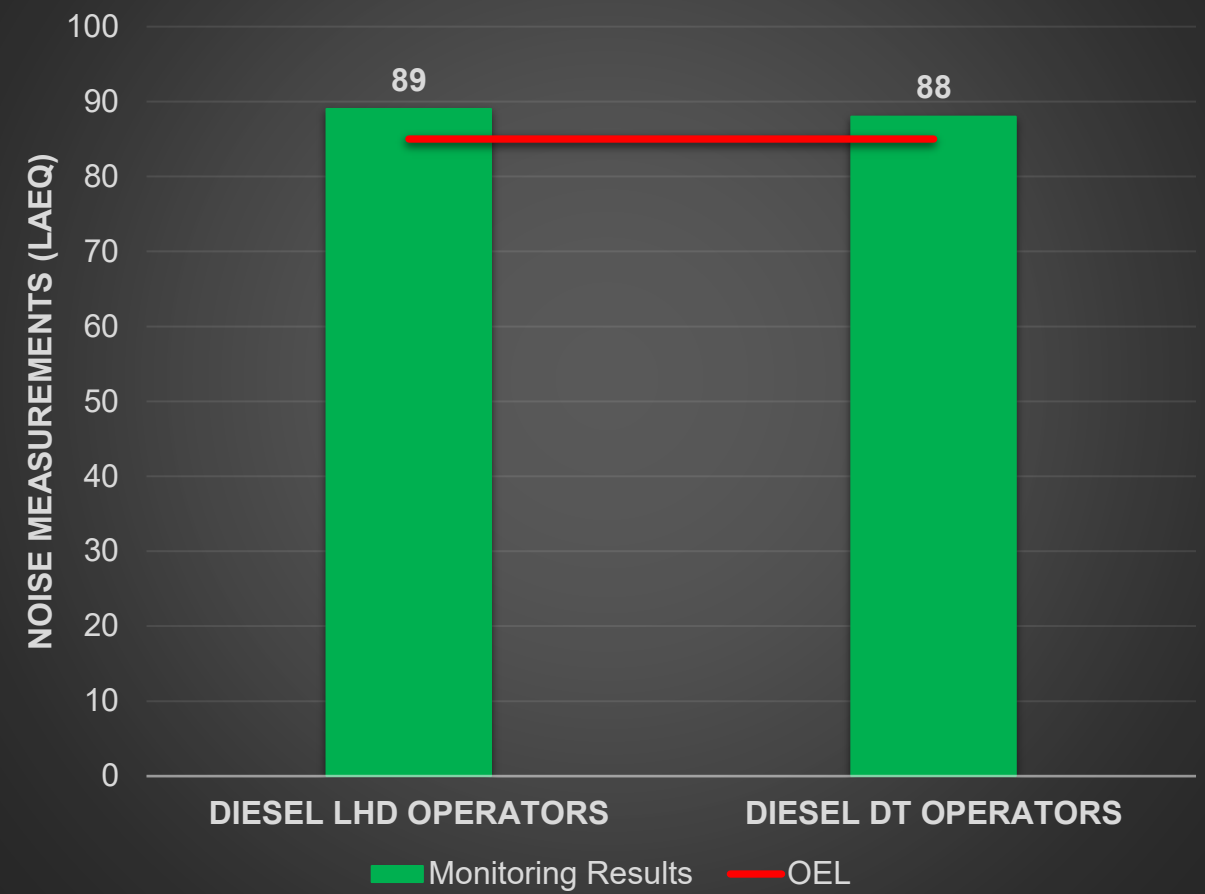
1. **Reduction of Noise Exposure**
2. Reduction of long and major breakdowns
3. Reduction of Travel Cycle

BRMO: NOISE RISK PROFILE (DIESEL EQUIPMENT)

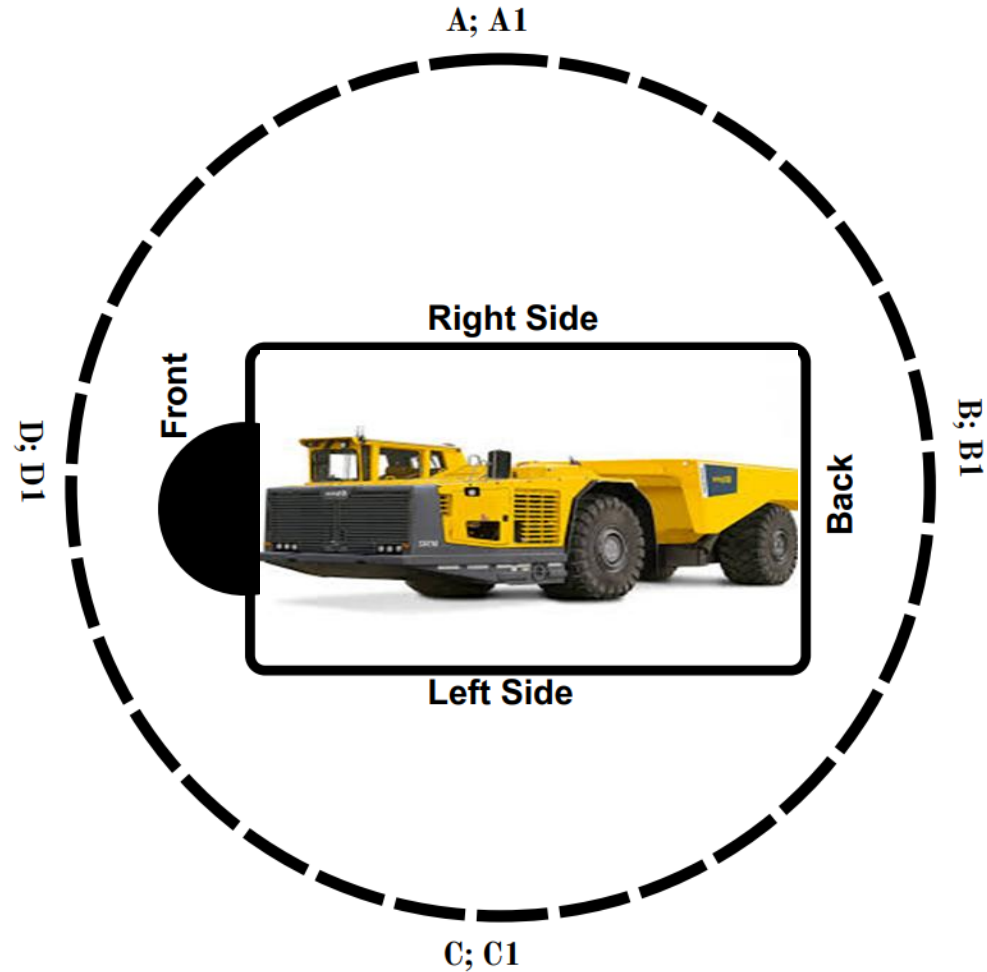
Diesel Equipment Noise Emission Profile



Personal Monitoring Results Profile



BRMO: QUANTIFICATION OF NOISE REDUCTION

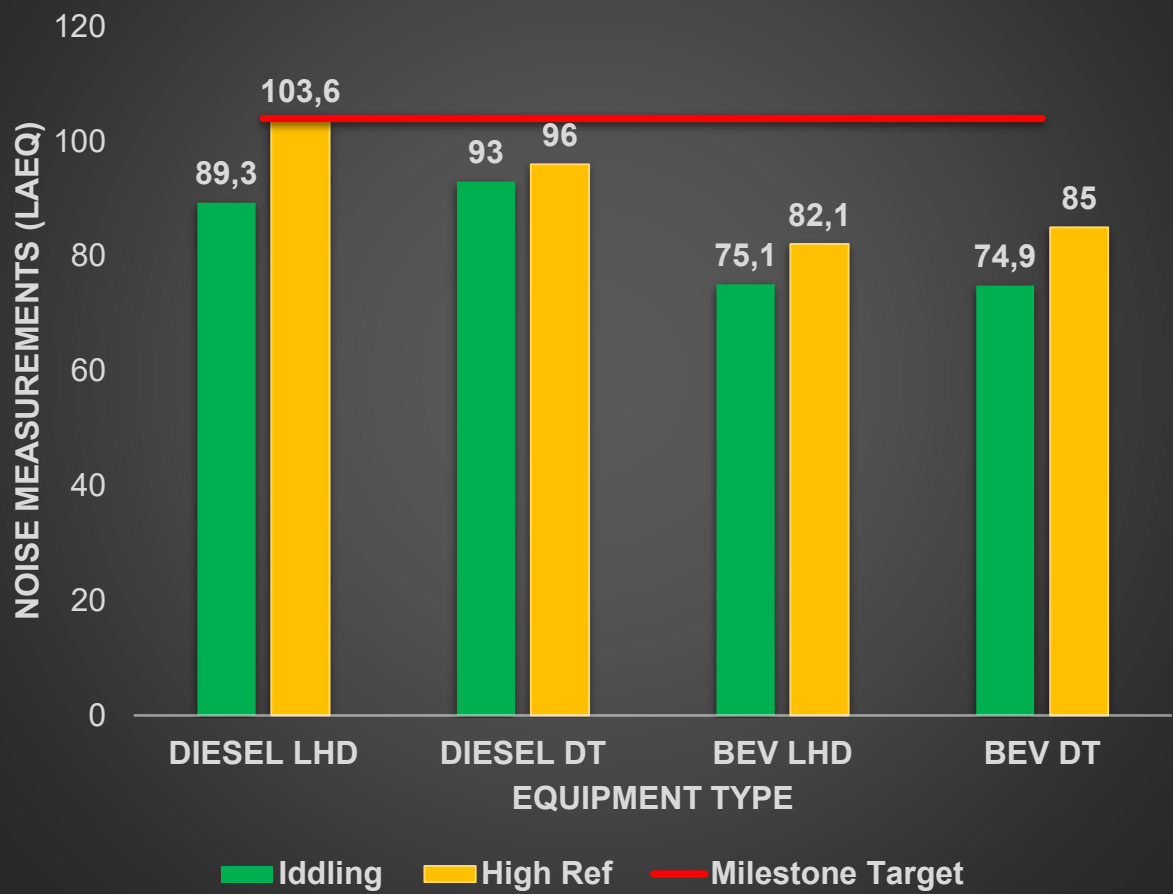


Noise measurements were conducted in accordance with the *Noise **Measurements Guidance Note***. In this context, the letters A–D refer to idling conditions, while A1–D1 correspond to full-load conditions. Safety requirements were duly considered, particularly with respect to maintaining appropriate safe distances.

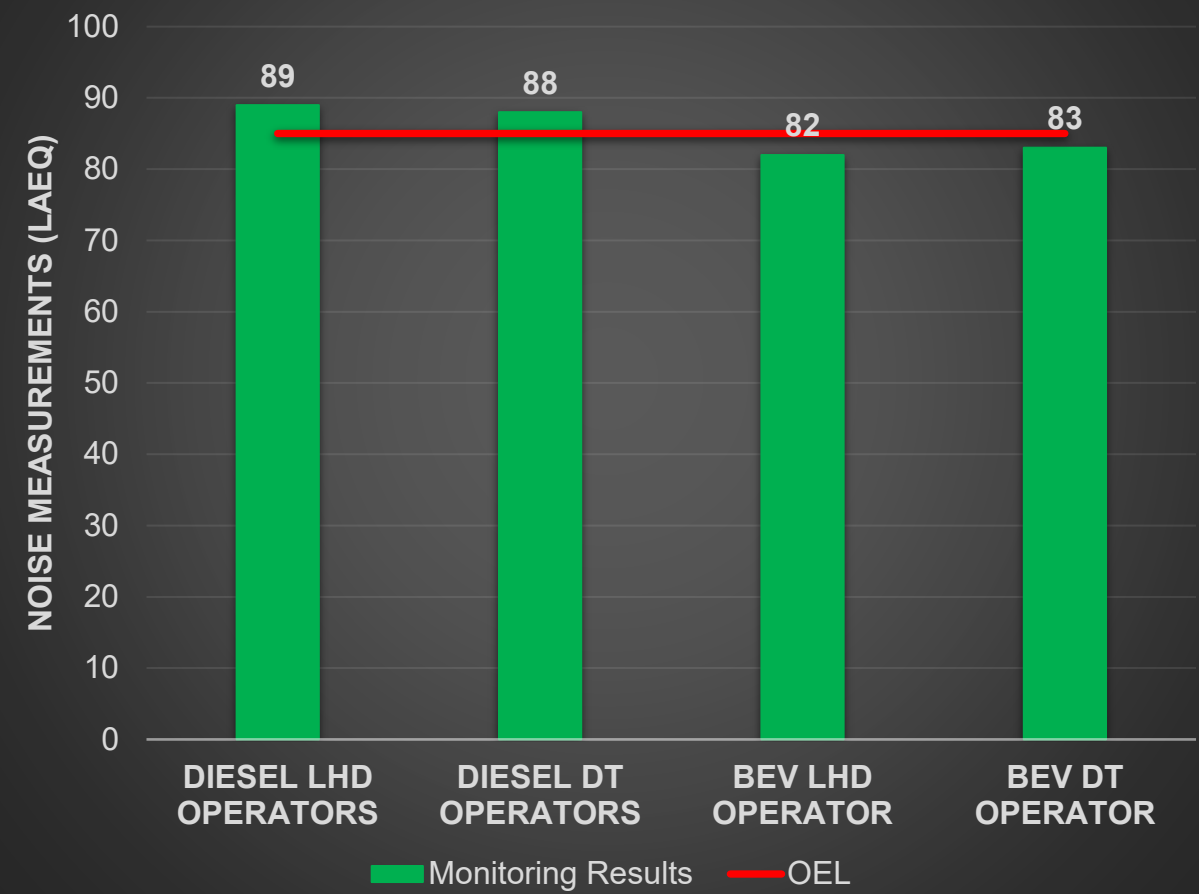
We '**Connect**' to Drive Performance Excellence.

BRMO: QUANTIFICATION OF NOISE REDUCTION

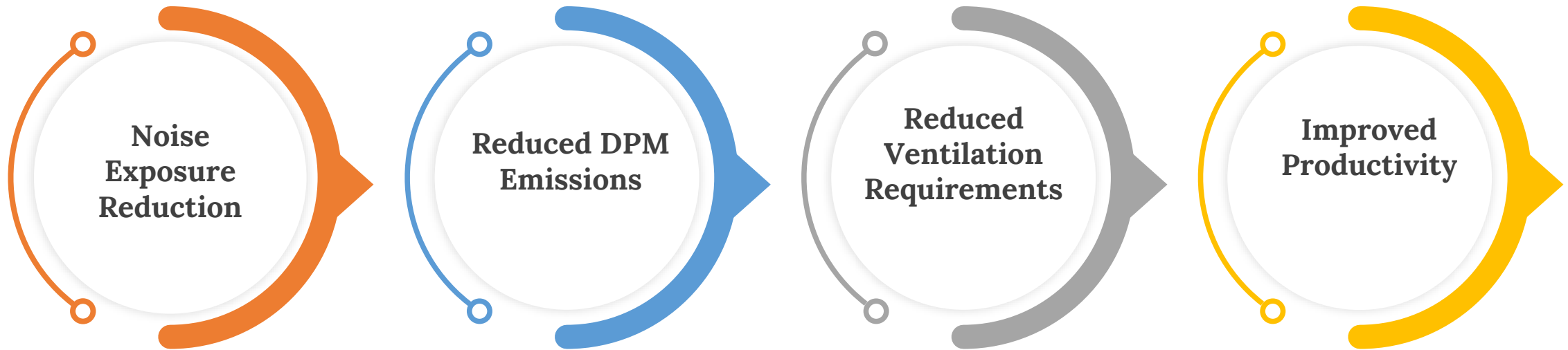
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Personal Monitoring Results Profile

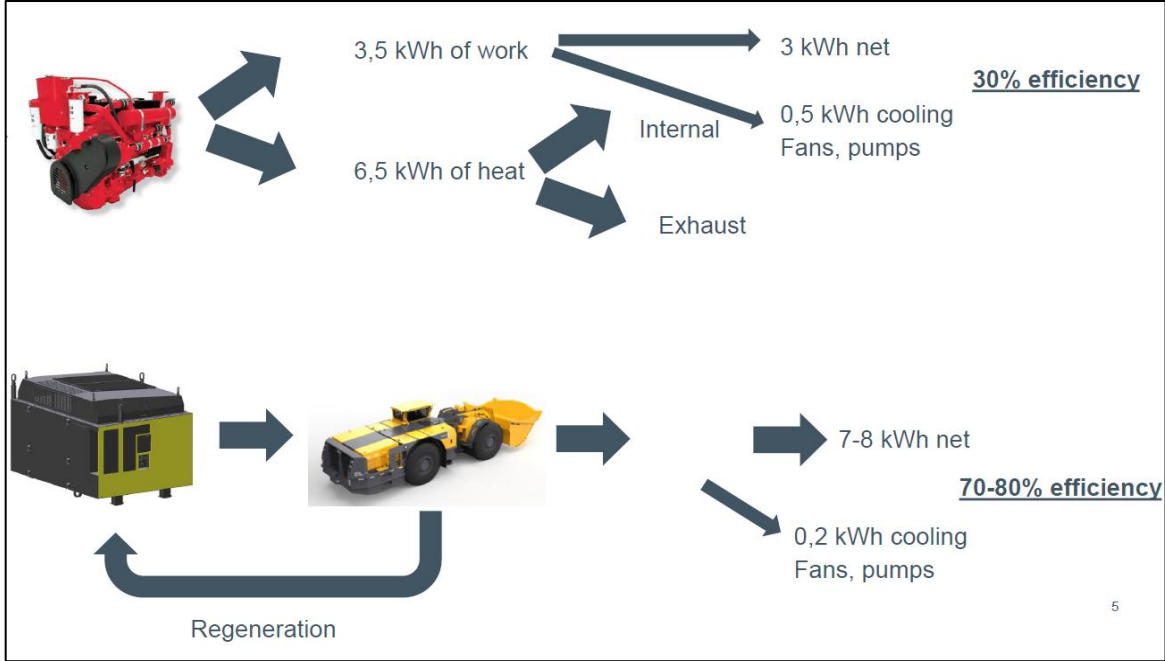


BENEFITS

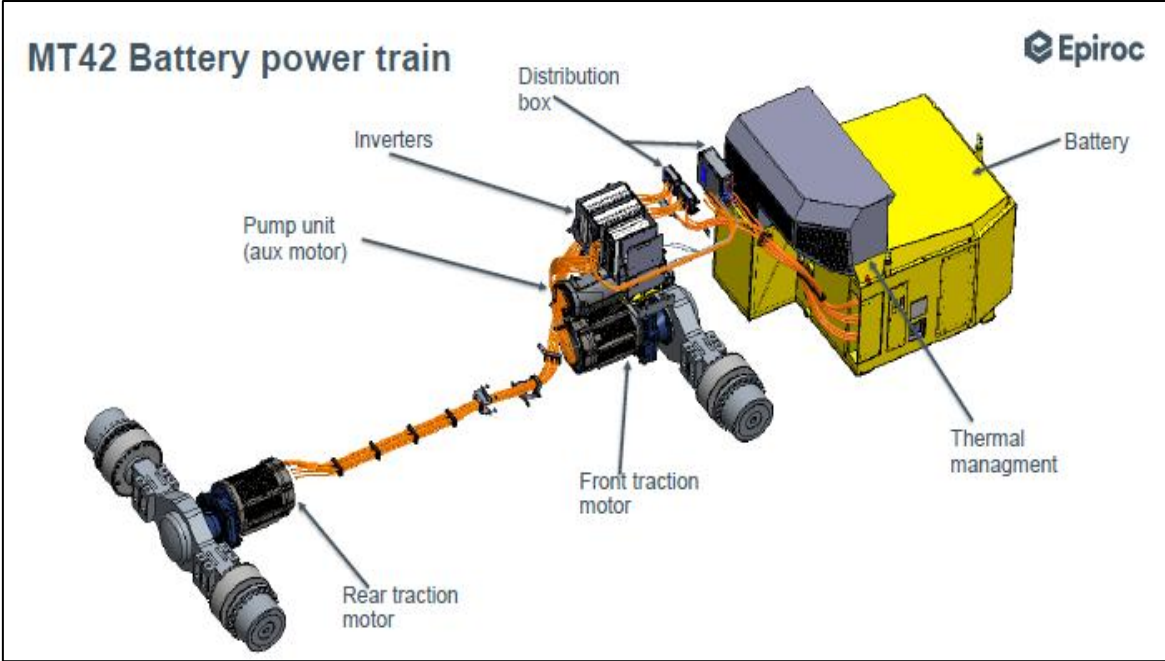


BRMO: BATTERY ELECTRIC VEHICLES

Electrification of mines is high on the agenda as a driver to reduce cost, improve energy efficiency, and enhance operational stewardship. Energy efficiency on diesel machines is as low as 30%, with up to 65% of power lost in heat generation. In battery electric vehicles (BEV), the efficiency is between 70% and 80%, with the ability to regenerate power downhill.

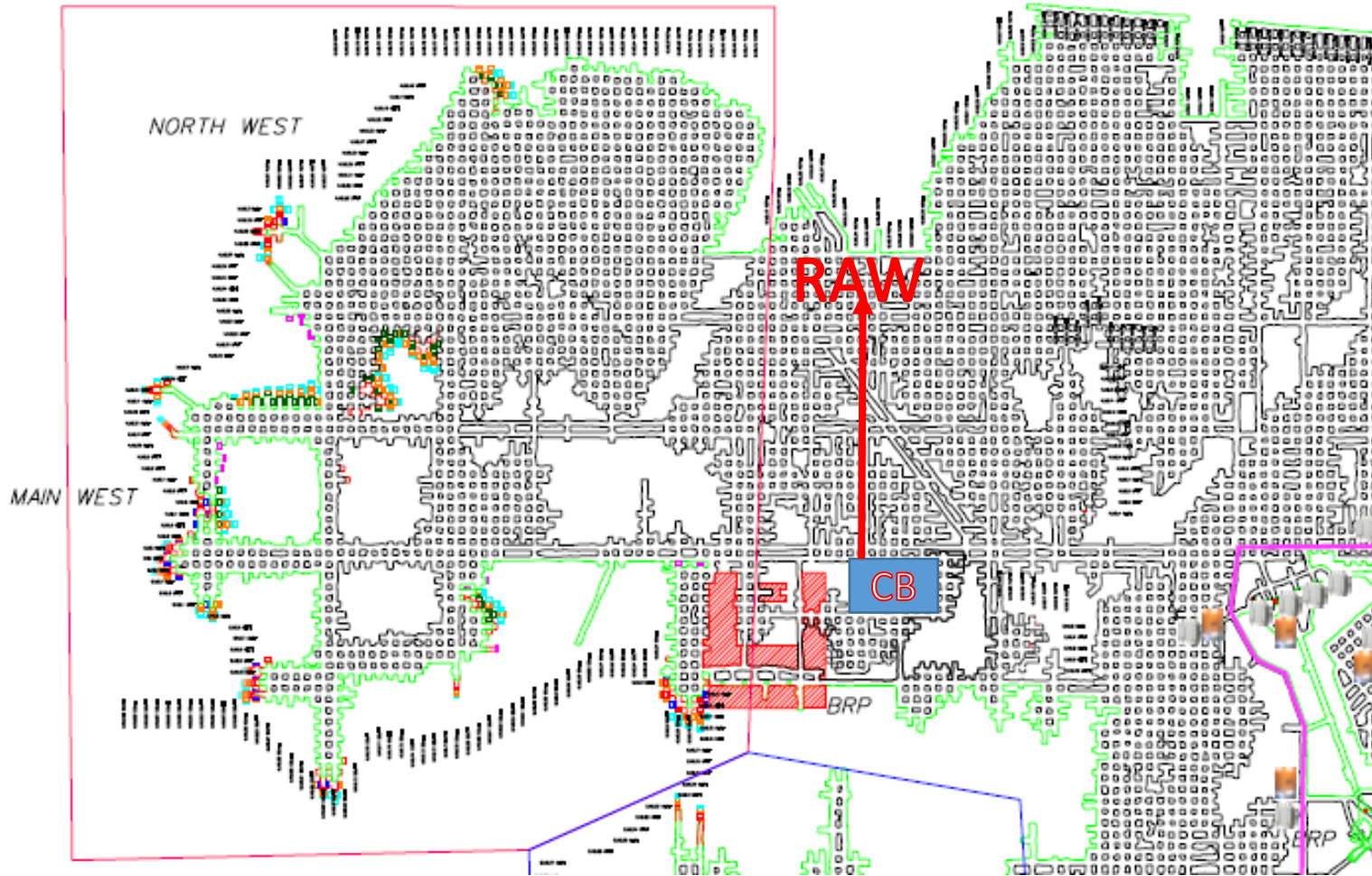


Not having an engine and fewer service points, battery operated vehicles have 25-30% less maintenance cost. Smooth power delivery through an electrical setup allows BEV's have a better average speed. This reduces the cycle time for each load with up to 9% increase in tonnes hauled. Speed control is easier with no gears having to be blocked



BRMO: CHARGING BAY

BRMO has invested in building a Charging Bay for the BEV fleet strategically placed for safe operation in the North section of Nchwaning 3 shaft



Position of the Charging Bay

The initial location of the Charging bay was influenced by conventional battery principles.

Upon consulting with the battery supplier on battery safety, the bay was moved to a more accessible area, still allowing for short-circuit of ventilation to RAW in case of emergency.

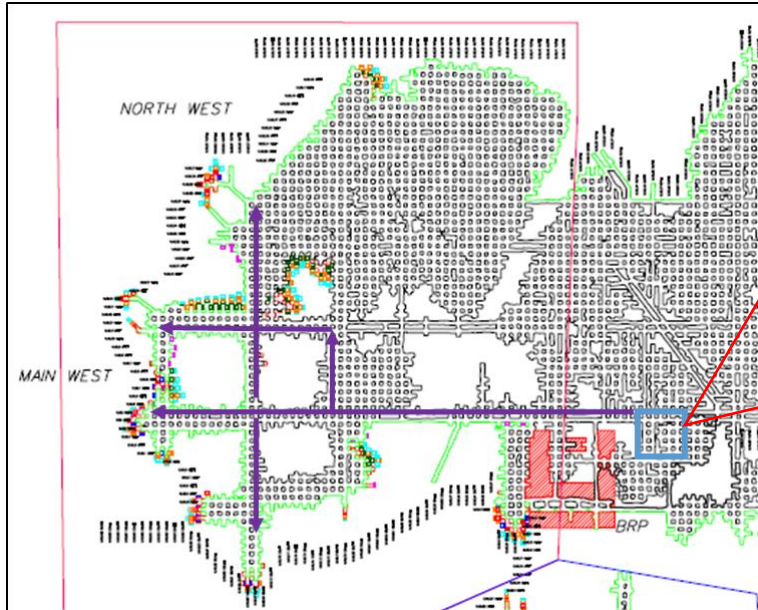
Roof height was critical for safe exchange of batteries; the current location could be mined to enable this critical function.

BRMO: OPERATIONAL PLAN

Operating area

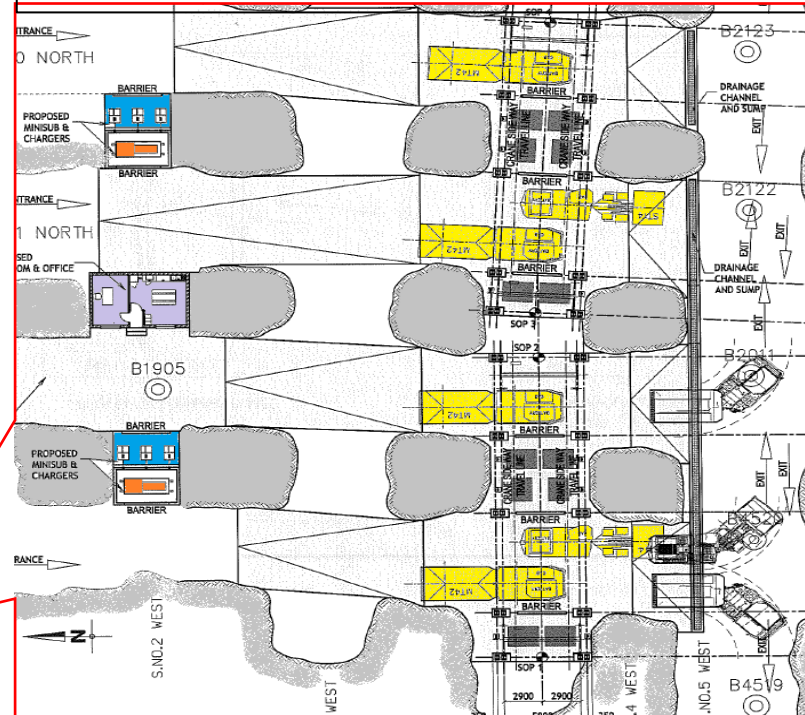
To fully test the capabilities and limitations of the section of Nchwaning 3. Impact of BEVs on ventilation

- Heat generation vs diesel counterparts
- Diesel Particulate Matter elimination
- Noise reduction
- Technology maturity
- Cost of ownership



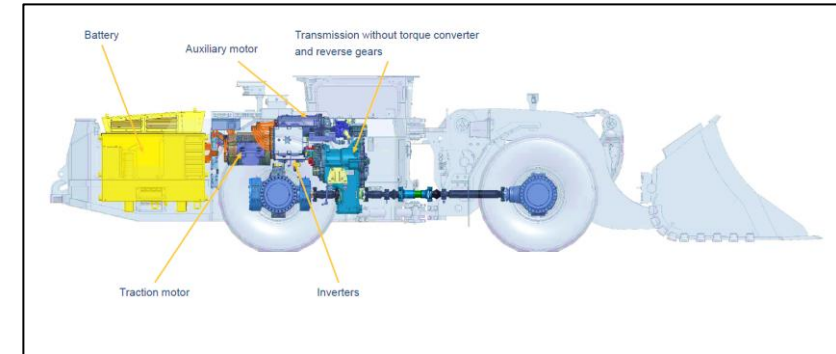
Battery Charge/Exchange

Initial simulations show that the batteries will not last a full production shift, a battery swop is planned mid-shift in the Charging Bay. End-of-shift the operator will park the machine in the parking bay and connect it for charging for the next shift



Maintenance

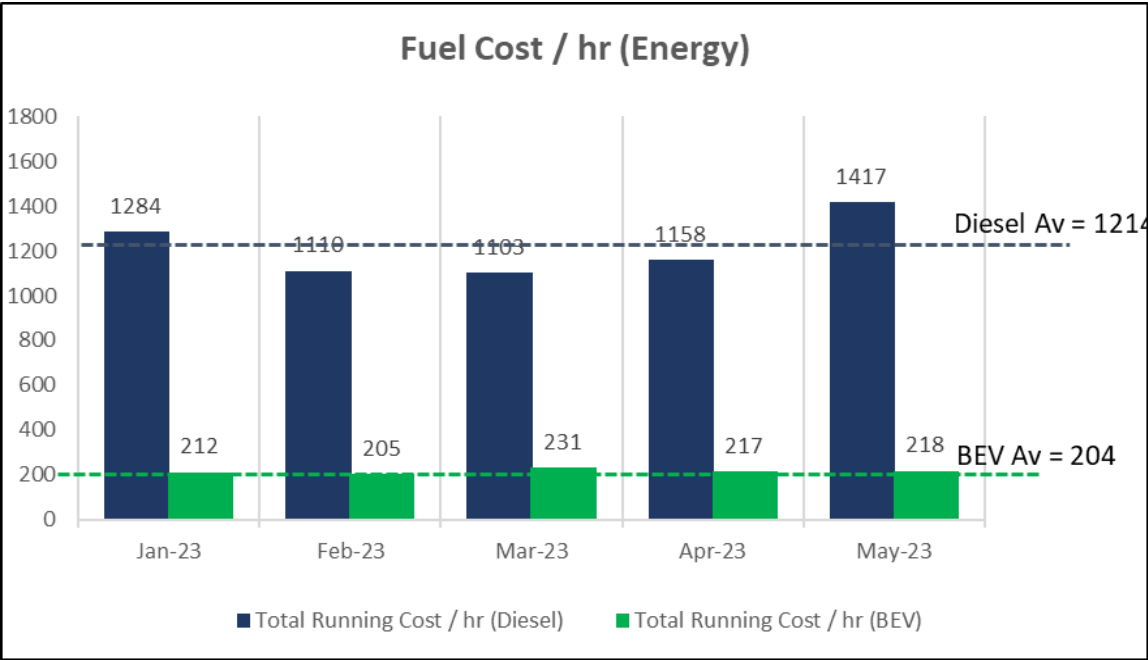
Daily machine maintenance and checks will be performed in the Charging Bay. For drive-train ns larger maintenance the machine will be send to the current Engineering workshop



OPERATING COST (ENERGY & LUBE COMPARISON)

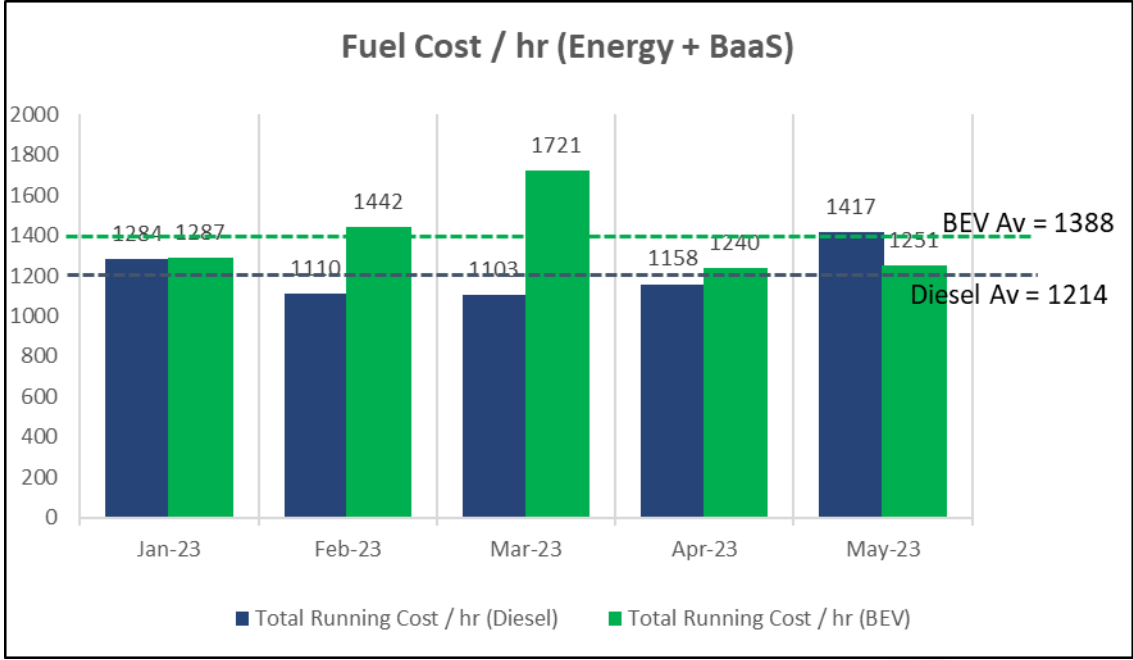
Electrical Energy cost vs. Diesel cost per hour

- Used actual charging energy readings @ R1,27 per kWh – avg. BRMO megaplex
- Fuel @ R22 per litre of diesel
- Electrical Energy costs 6x less



Electrical Energy cost incl. Battery Rental vs. Diesel cost per hour

- Battery ratio per machine - major impact



**** Lubrication usage at R500/hr for Diesel Vehicles and R110/hr for BEVs**

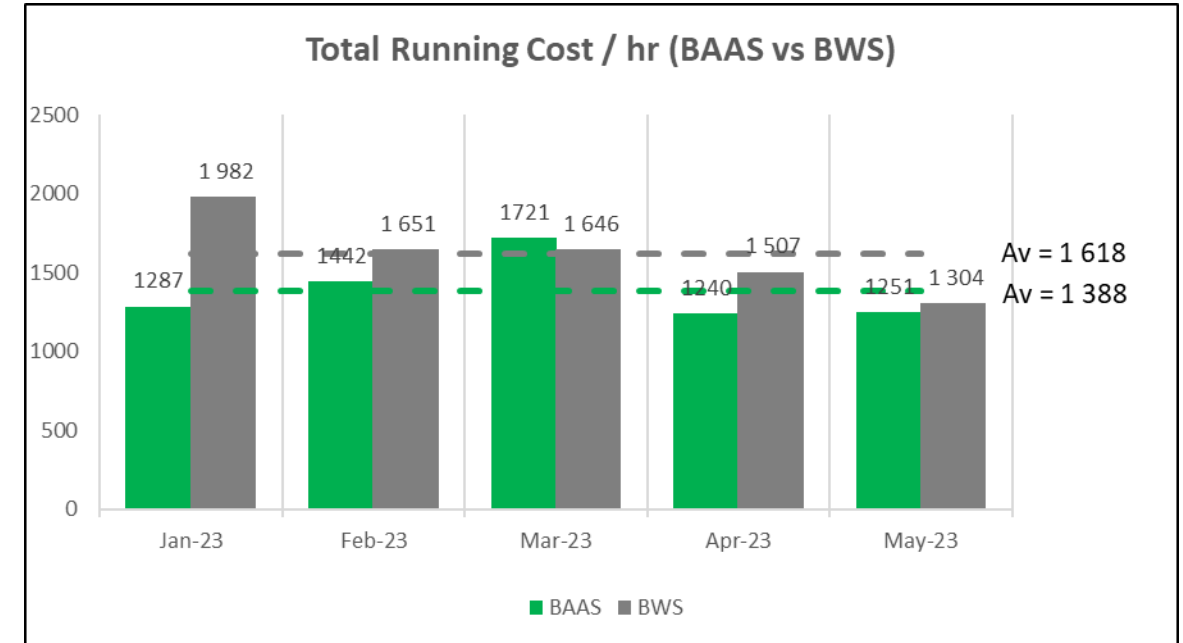
OPERATING COST (ENERGY & LUBE COMPARISON)

New battery pack price, per pack, for sale:

- ST14 – B4ST - R 11.8m
- MT42 – B5MT - R 14.8m

For Battery with a Service (BwS):

- Monthly BwS Cost per B4 ST Battery – R 37k
- Monthly BwS Cost per B5 MT Battery – R 44k
- Monthly costs will apply to the Extended Warranty and the Support (Quarterly scan), without any additional SLA



PURCHASE COST VS. 4 MAIN FANS RUNNING

TMM	BEV	DIESEL	Difference
LHD	R 25m	R 21m	R 4m
DT	R 27m	R 16m	R 11m

Main Fan Station	Installed	Operating	Quantity (m³/s)/Fan	Pressure Pa	Power	Running Cost (ZAR)
3x Centrifugal	Parallel	3x fans	104	1 560	270	R 8,5m
Backup fan	Parallel	4x fans	104	2350	330	R 13,8M
Total Upcast Volume			416			

KEY LEARNINGS

- ☐ Traffic Plan
- ☐ Electrical charging infrastructure.
- ☐ Charging of batteries – On and off the machine.
- ☐ Battery Change.
- ☐ Oil services and minor repair facilities
- ☐ Operators Training
- ☐ Need for CAS Level 9
- ☐ Skills Shortages



Questions ?

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By Chief Occupational Hygiene and Ventilation
Chief Fire Master
Humbelani Phunge

