

# MDEC 2022 BEV Program Design Journey

September 2022



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## AGENDA

- Who we are.
- EV Program Introduction and proof of concept.
- EV Program Current Status.
- What have we learned?
- What is not included, what are we missing?
- Next steps



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### **WHO WE ARE.**

#### **History**

- Founded in 1973 in Ontario, Canada, remains privately held
- 1000+ employees globally (700+ in Canada)
- 2400+ units commissioned to date
- Canada's largest mining OEM
- EV Program launched in 2015 with 3 units.

#### **Value proposition**

- Extensive hard rock mining experience
- Multi-discipline engineering
- Integrated design, manufacturing and assembly
- International sales, customer service and support
- Complete EV Fleet of service and support Equipment.



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### **The original design decisions.**

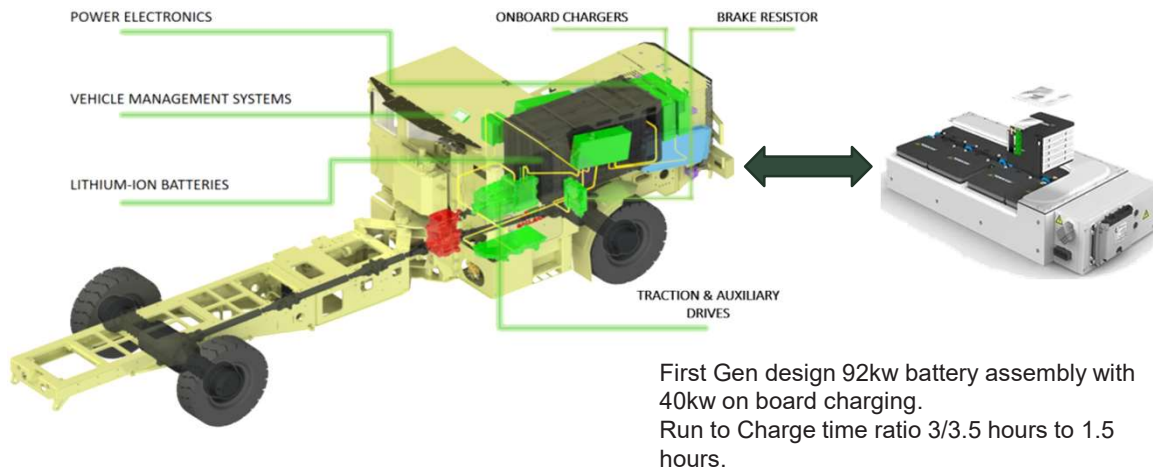
- Our design was based on sourcing the best-in-class components and integrate into our mobile equipment, as opposed to purchasing a complete off the rack solution.
- **Why?** this allows us to integrate new and developing components specifically chargers and batteries as new technology was and is still evolving at a rapid pace.
- Choose long life batteries that would go in and stay in the units.
- **Why?** no time spent swapping, no additional infrastructure required or additional batteries.
- Our charging method was based on providing an on-board charging solution.
- **Why?** fastest path to market, compatible with all current underground electrical grids, standard plugs and receptables, accepted and understood process ( we charge several diesel products like bolters and sprayers this way now) No new standards, training or cultural issues to deal with. No new charging infrastructure needed at customers sites.
- The above was all possible based on our current mobile platforms and vehicle weight class and required duty cycles.



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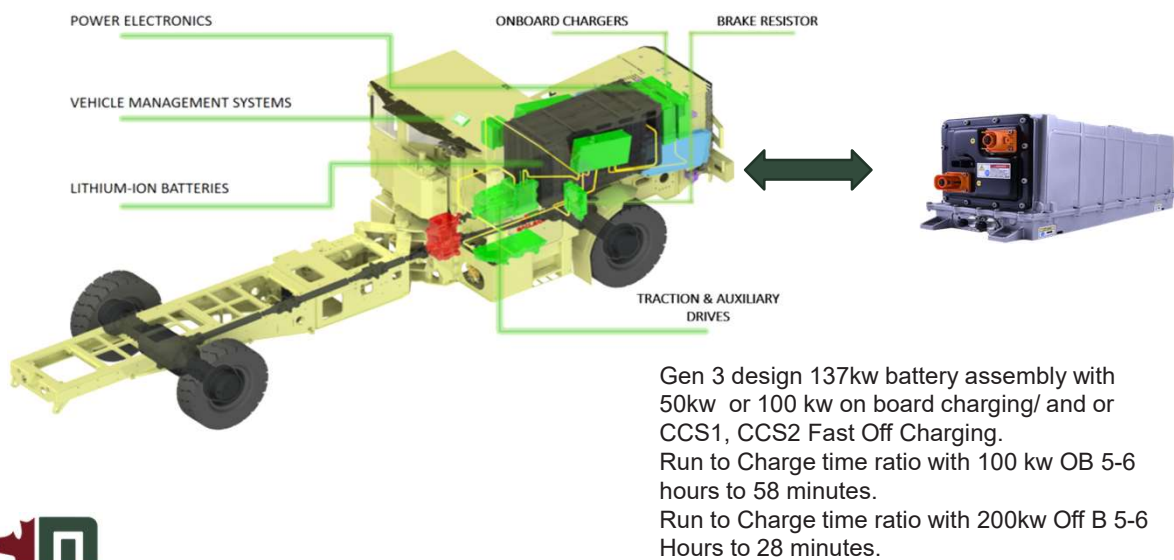
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## EV Program Introduction GEN 1.



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## EV Program Introduction GEN 3



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## Current availability of the MacLean EV Product Line.

- CS3 Cassette truck ( available)
- AC3 ANFO loader ( available)
- EC3 Emulsion Loader ( available)
- BH3 Blockholer ( available)
- BT3 Boom truck ( available)
- SS5 Shotcrete sprayer ( available)
- TM3 Transmixer ( available)
- SL3 Scissor lift ( available)
- 975 Bolter ( available)
- GR5 Grader ( available 2022 Q4)
- RB3 Rock breaker ( available 2022 Q4)
- RS3 Scaler ( available 2023)
- FR3 Forklift ( available 2023)
- If we make it in diesel, we will offer an EV version



From the original 3 units we have expanded the fleet to over 54 units made up of over 13 + different product lines to provide the widest fleet offering available for the U/G mining sector.

During this fleet development we have continuously tested and refined our design based on the results. Our original design provided us with data on individual units but as part of our innovation road map our VMS option is now standard on all our EV units, and this allows us to gather huge amounts of operating and performance data for analysis.



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## New 98P Power Cell Subpack



Battery Option (Standard 2-String Battery Assembly)	New 98P Power Cells	Current 76P Power Cells
Energy Capacity	137 kWh	106 kWh
Usable Energy	123 kWh	95 kWh
Recommended Energy (Based on Recommended Range)	96 kWh	74 kWh
Recommended Range	20-90 % SoC	20-90 % SoC
Spec Sheet Cycle Life	>10,000 Cycles (@ 80% DOD)	>11,000 Cycles (@ 80% DOD)
Maximum Discharge Rate	4.3C / 475A	5.5C / 475A
Maximum Charge Rate	3.0C / 330A	3.6C / 330A
Charge Time with 50 kW On-Board Charger (Standard Offering)	121 minutes	95 minutes
Charge Time with 100 kW On-Board Charger	58 minutes	45 minutes
Charge Time with 200kW CCS1 or CCS2 Off-Board Charger	28 minutes	22 minutes



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## CCS1 & CCS2 Off-Board Charger Options



200kW CCS1 & CCS2 Off-board Chargers



Pedestal Options



Wall Mount Option



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## MacLean EV Network Effect 2016 – 2022: EV Fleet Population.



### Global EV Demo Fleet:

- 1 Boom truck (BT3) in RSA.
- 1 Transmixer (TM3) in Sudbury.
- 1 Shotcrete Sprayer (SS5) in Sudbury.
- 2 Demo/Research Bolters (975) in Sudbury.
- 1 Cassette Truck (CS3) in Sudbury.
- 1 EV Shotcrete Sprayer (SS5) in Australia.
- 1 EV Charger (MC5) for Australia.
- 1 EV Multi-Lift (ML5) for Australia.

### Latest EV Order

Glencore-Onaping Depth Project  
fleet order for 17 EVs.

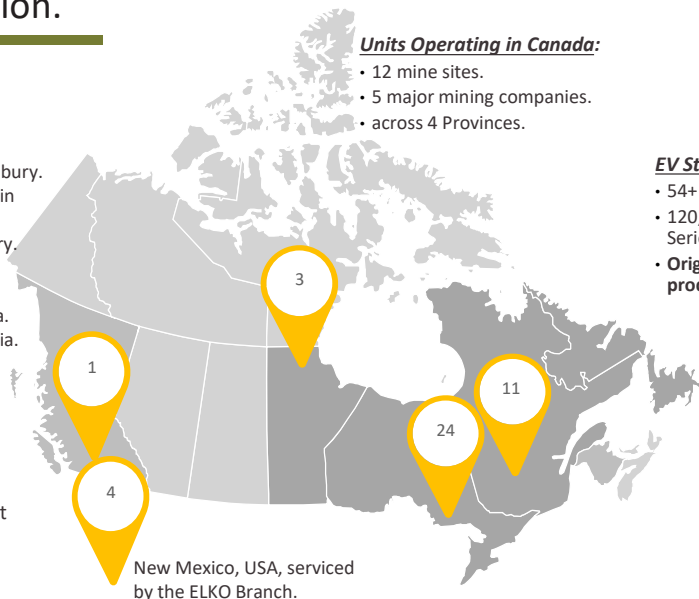


### Units Operating in Canada:

- 12 mine sites.
- 5 major mining companies.
- across 4 Provinces.

### EV Statistics:

- 54+ BEVs working underground.
- 120,000+ operating hours since EV Series launch 2016.
- Original 3 EVs, still operating after product launch in 2016.



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## EV Program and what is on the radar.

- 11 major EV projects in the planning/Quoting stage representing a minimum of 156 units.
- EV interest is coming in from all major mining jurisdictions and more and more requests for quote are for “EV only” in 2015 and 2016 it was diesel only and EV was listed as an alternative product offering the tide is starting to shift.
- Why .....what is driving this shift aside from the obvious use of batteries such as reducing diesel use, less noise, no significant heat given off, no off gassing, no DPM?

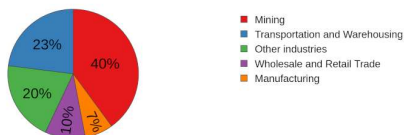


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According to the Occupational Cancer Research Centre, based on 2011 cancer statistics, approximately 560 lung cancers and 200 suspected bladder cancers in Canada are attributed to occupational exposure to DEE each year. Out of those, 220 lung cancers and 20 suspected bladder cancers are estimated to occur among those in the mining industry.

Lung Cancer Cases From Occupational Exposure to DEE (2011)



## World's largest miners pledge net zero carbon emissions by 2050

### Net-zero investment

Companies need both short-term and long-term emission-reduction plans and investors want to know what they are

### CA\$40 per tonne

Currently, all provinces and territories are subject to a carbon pricing mechanism, either by an in-province program or by one of two federal programs. As of April 2021, the federal minimum tax is set at CA\$40 per tonne of CO<sub>2</sub> equivalent, set to increase to CA\$50 in 2022 and CA\$170 in 2030.

**The public will need to accept greater mining activity if the world is to meet the challenge of going green.**

Resource experts say the current supply of various metals and minerals cannot support a global economy producing net zero carbon emissions.



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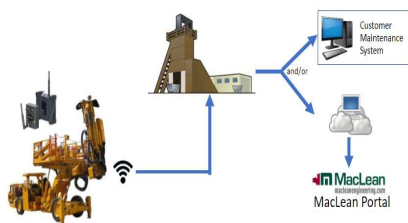
## What have we learned so far?

- Understanding of the duty cycle is important as a first step, a one sized battery solution will not fit all applications.
- Charging methods need to be flexible and be compatible to the mine design and duty cycle.
- Unit Run time to charge time ratio needs to be considered as part of the overall duty cycle.
- The battery energy density is lower than that of diesel so understanding the above three points when considering EV adoption can help provide an acceptable and economical alternative to diesel units.
- Understanding of the duty cycle and opportunity charging can turn a simple duty cycle of a 2.5km return run for a boom truck from 4 runs in 3 hours( followed by a full charge) into 12 runs in 10 hours ( using idle time as charge time)
- A complete EV fleet, comprised of 14 pieces of MacLean EV Equipment, over the course of a year can save \$1,789,387.00 on diesel costs when compared against the equivalent MacLean diesel units.( Assuming Electricity cost is \$ .12/hr. and diesel is \$2.5/L ) This study was based on 58,381 operating hours over the course of the year.
- Monitoring the battery performance is essential for safety and operating efficiency.



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## Vehicle Monitoring and Telemetry System



- Typical screen shown installed in operator's compartment, standard on all EV units.
- Main screen shown with overall battery and vehicle information
- The vehicle monitoring system logs data via USB to the PLC locally then awaits a WiFi or LTE connection to upload. The USB data storage is up to 5000 hours of run time.
- Data upload can be migrated to customer site servers/portals or MacLean portals or both
- Faults detected during data uploads (which are also viewable in real time on the screen as they occur) will trigger notifications to internal MacLean support staff and can also be sent via email to customer contacts
- Data capture, analysis and reporting options can provide monitoring on all aspects of an EV unit, Fleet or Fleets in order to provide optimum performance

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#### What is not included, what is missing in the data

- The effects of eliminating heat by removing diesel engines from U/G.
- The effects of eliminating noise and vibration caused by diesel engines.
- The effects of eliminating DPM.
- Why does this matter?
- Workplace Health and Safety, GHG impact and ESG factors are now playing a much bigger role than ever before, increasing safety, reducing our Carbon footprint and how we conduct our business is more important than ever.
- The adoption of EV units can go a long way to assist, and future proof new and existing projects with the new challenges the mining sector is facing such as carbon pricing increases, ESG considerations, social license, worker health, attract new employees, investor appeal.



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#### What is next?

- Continuing to collect and share data from the fleet.
- Test, test and more testing to determine more defined results for heat, noise and vibration from our equipment by third party experts at our U/G test site in Magill.
- Continue to refine our design by eliminating parasitic losses.
- Continue to electrify standard MacLean units.
- Continue to look and source the latest in EV components that are quickly coming to the developing EV supply chain.
- Continue to look for opportunities to expand our fleet with new products...grader and forklifts.



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