



Artisan Vehicle Systems





What I learned at Minexpo

- **OEMs are taking the trend seriously and are offering battery products**
- **Mine companies realize that this is the future**
- **More products need to hit the market in order to affect mine design**
- **Costs models need to be explained to mining companies and consultants**

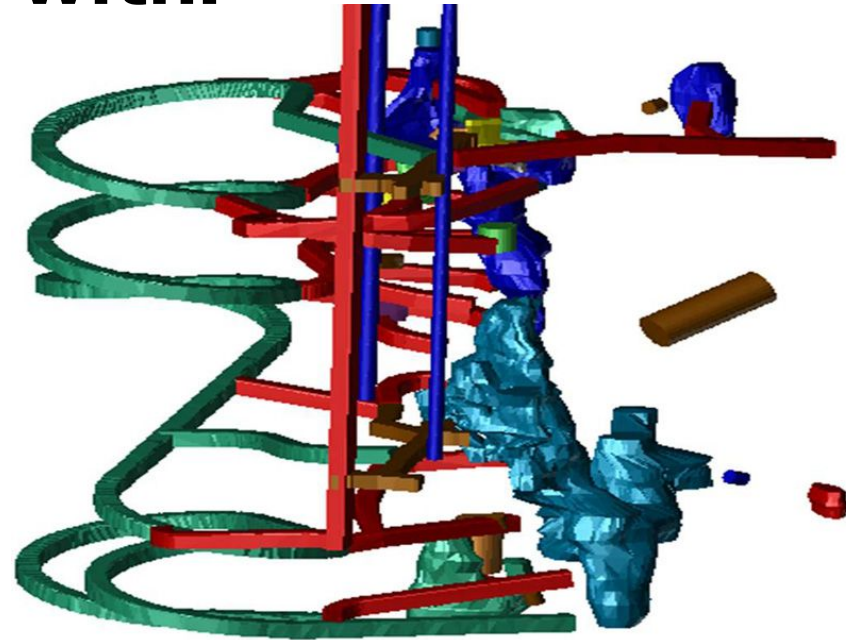




Mine Companies are at a Crossroads

**In planning for the next several years,
how do we move forward with:**

- 1. New mine design**
- 2. Mine expansions**
- 3. Existing fleet upkeep**



Do we use Diesel or Battery?



Choosing Diesel

Pros

- Proven technology
- Known results
- Predictable
- Direct experience



Cons

- Tier 4 compliance is costly
- Uneconomical in deep mines
- Unhealthy for UG workers



Health Risks of Diesel



**World Health
Organization**

**“Diesel is a Known
Carcinogen”**

- **UG mine workers are...**
 - **exposed to 100 times the diesel exhaust**
 - **3 times more likely to get lung cancer**
- **The road to the healthy use of diesel is onerous, costly...and unlikely**



Choosing Battery

Pros

- **Less ventilation**
- **Less cooling**
- **Enables deep mines**
- **Faster time to production**
- **Better financials**
- **Regulation is coming**

Cons

- **Unproven**
- **Unavailable**
- **No direct experience**
- **Real costs are unknown**
- **Increased risk to missing objectives**





Kirkland Lake Gold



KIRKLAND LAKE GOLD

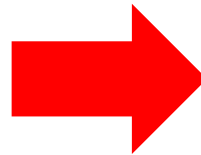
- **Over five years experience**
- **Large fleet of battery powered primary movers**
- **Faster, less expensive access to rich reserves**
- **Quadrupled stock price since 2013**
- **Acquired St Andrew and Newmarket Gold**



The Tipping Point is Coming

Definition:

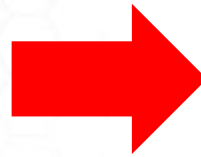
The point at which a series of small changes or incidents becomes significant enough to cause a larger, more important change.





Affecting Positive Change

Today's Discussion:



Tomorrow's Discussion:

- Will battery work?
 - Is it cost effective?
 - Is it higher risk than diesel?
- Who has implemented battery successfully?
 - What is the best mine design?
 - What are the real financials?



Applying Experience to Address Risks and Unknowns

The data exists:

- **Energy used**
- **Heat generated**
- **Work completed**
- **Maintenance costs**
- **Infrastructure costs**
- **Real benefits**
- **Performance**
 - Tons moved per shift
 - Charge time
 - Battery life
- **Maintenance**
 - Staff expertise
 - Service contracts
- **Infrastructure**
 - Grid requirements
 - Ventilation
 - Cooling
- **Mine design**
- **Financial modeling**



Mining Company Objective: Produce More Ore

**300% of the
horsepower**

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**More Torque for
Faster Loading**

**30% more load
per bucket**



**20% Shorter for
Better Maneuverability**

**20% Tighter
Turning Radius**



Mining Company Objective: Reduce Costs

**Radical reduction
in ventilation
CapEx**

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**Lower Ventilation
and Cooling
OpEx**



**Significant reduction
in cooling CapEx**

**No increase in
machine OpEx**



More Offerings are Needed!

Battery Equipment Launches:

- Artisan
- Atlas Copco
- Sandvik
- Aramine
- RDH
- Maclean
- IFI Minecat
- Others

What's Next?

- A comprehensive set of products is needed.
- Primary movers, utility, support, personnel, etc.



Slide from Last Year's MDEC

The Year is 2020

- All tenders ask for only zero emission equipment
- Diesel is no longer an option in new equipment
- A few diesel engines remain underground, but are being phased out
- Cost per ton is lower industry wide, mine company financial health has improved



Thank you

