

MEDATECH  
///ALTDRIIVE

# BATTERY-ELECTRIC POWERTRAIN SOLUTIONS FOR HEAVY EQUIPMENT



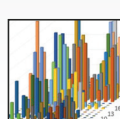




BATTERY-ELECTRIC POWERTRAINS / KITS | ELECTRIC CONVERSIONS | FEASIBILITY & CONSULTING | CHARGING





# POWERING THE BATTERY-ELECTRIC ECOSYSTEM

MEDATech’s ALTDRIVE division has been developing, building and delivering battery-electric powertrain equipment for over a decade. We are focused on getting OEMs and equipment end users the battery-electric powertrains for their equipment they need quickly and efficiently. You can find ALTDRIVE powertrains hard at work in mining and other heavy industries worldwide.

	<b>BATTERY-ELECTRIC POWERTRAINS</b> ALTDRIVE powertrain system technology is designed and built specifically for harsh and demanding applications.	<b>page 4</b>
	<b>BATTERY-ELECTRIC &amp; DIESEL-ELECTRIC HYBRID CONVERSIONS</b> Converting a heavy vehicle from diesel to electric is often the first step to fleet-wide electrification. We convert vehicles to full battery-electric, or hybrid diesel.	<b>page 6</b>
	<b>ELECTRIFICATION FEASIBILITY STUDIES</b> Fleet Feasibility Studies start by mapping out vehicle duty cycles and simulating each vehicle requirement over its duty cycle to provide valuable performance data. The result is a breakdown of emission reductions, costs, and savings over time versus diesel.	<b>page 7</b>
	<b>BATTERY-ELECTRIC POWERTRAIN KITS</b> We design and supply pre-configured modular battery-electric kits for vehicles ranging from the size of a pickup truck to a heavy-haul tractor.	<b>page 8</b>
	<b>CHARGING TECHNOLOGY</b> We offer all on-board and off-board charger options, including fully-automated charging systems in the megawatt range.	<b>page 10</b>
	<b>ELECTRIFICATION CONSULTING</b> Whether it's the feasibility of converting one vehicle to electric, or planning a multi-year fleet transition at multiple sites, we have the expertise.	<b>page 11</b>
	<b>TECHNICAL CAPABILITIES</b> From high-fidelity EV simulation to in-house software design, to every aspect of building a vehicle, we handle the entire vehicle-electrification process.	<b>page 14</b>

# INNOVATIVE DESIGN & ENGINEERING

MEDATech stands for **M**obile **E**quipment **D**esign and **A**utomation **T**echnology. We have been designing and building custom-engineered industrial mobile equipment and software solutions for customers across the globe since 2003. We’re in the business of innovation.

**Our strength** Product development

**Our value** Quickly making your product vision a reality

**We support OEMs and end users in their electrification projects with the knowledge and skills that can save them time, effort and money.**

## MEDATECH DIVISIONS



Innovative design & engineering



Specialty drilling solutions



Battery-electric powertrain solutions

**Accelerating new product development**

Companies work with MEDATech in order to accelerate the product development process. For over 20 years we have been working tightly with customer teams and delivering on their ideas. We produce top solutions across industries, including Mining, Construction, Defense, Energy and Transportation.

## CUSTOMERS ACROSS INDUSTRIES





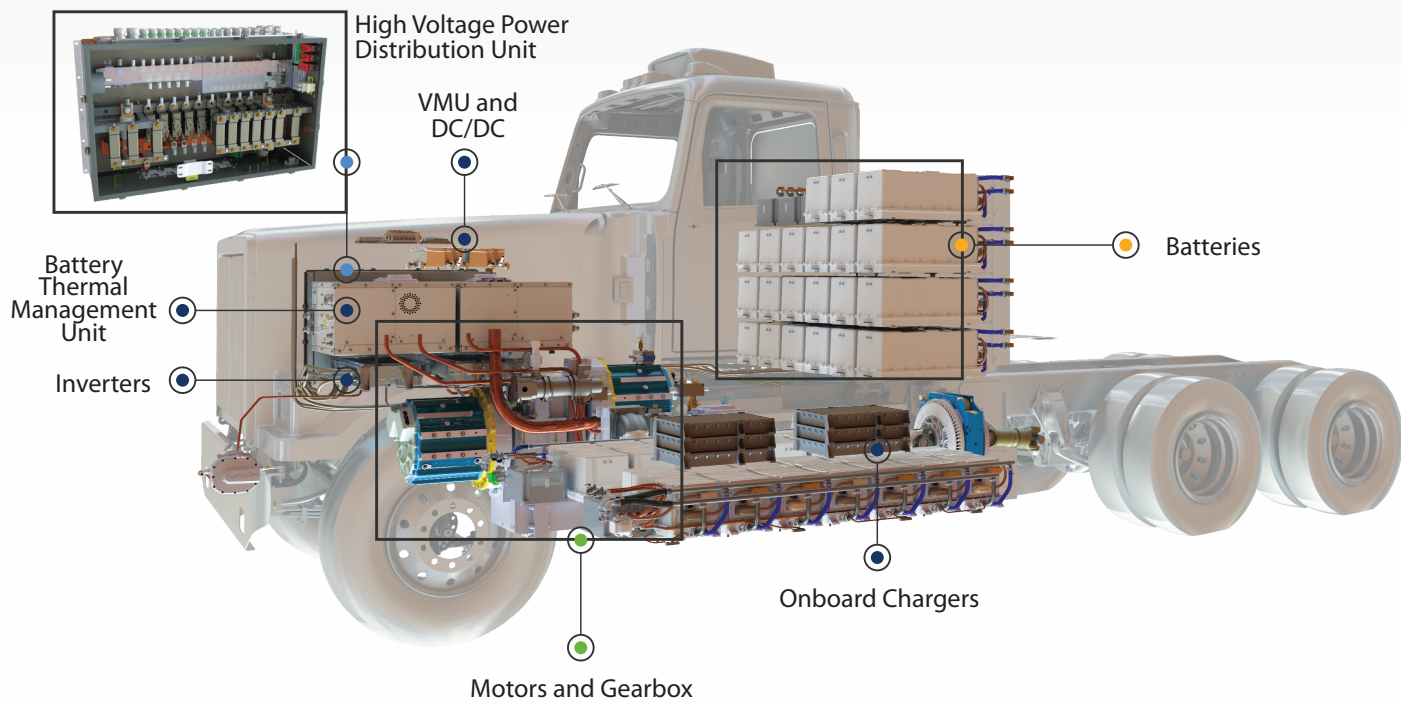


# BATTERY-ELECTRIC POWERTRAINS

We build turnkey battery-electric powertrains for industrial vehicles—from small utility vehicles to heavy mining haul trucks for end users and OEMs.

## SUPPORTING CUSTOMER OBJECTIVES

We’ve supported end user clients like Teck Resources and OEMs like Kovatera to achieve their objectives: shorten development time, reduce emissions & costs, and focus on what they do best. We can do the same for you.



## BUILDING FOR YOUR MACHINE’S DUTY CYCLE

Powertrains for heavy-duty battery-electric vehicles (BEVs) are a union of complex systems. Getting each one right, then making them all work together as intended, has proven elusive for many. Here are the three core elements to consider when building a BEV powertrain for a specific duty cycle:

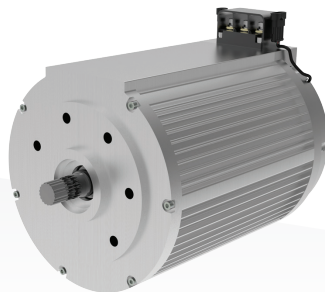
### Batteries



Batteries come with different chemistries. There are different performance and safety levels within those chemistries. The battery system is the major element that we need to consider with respect to suitability for the application, the duty cycle and the operating environment.

### Electric motors

Electric motors provide the power for traction, hydraulics and potentially other components, depending on the industrial machine. Motors need to be sized according to power-level requirements for each machine, ensuring that it is efficient as well as applicable for the environment.

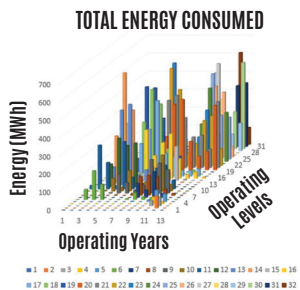


### Charging Technology



Charging infrastructure ranges from on-board and off-board charging to fully-automated high-powered off-board fast charging. Whatever the application demands, MEDATech can provide the solution.

## FEASIBILITY FIRST

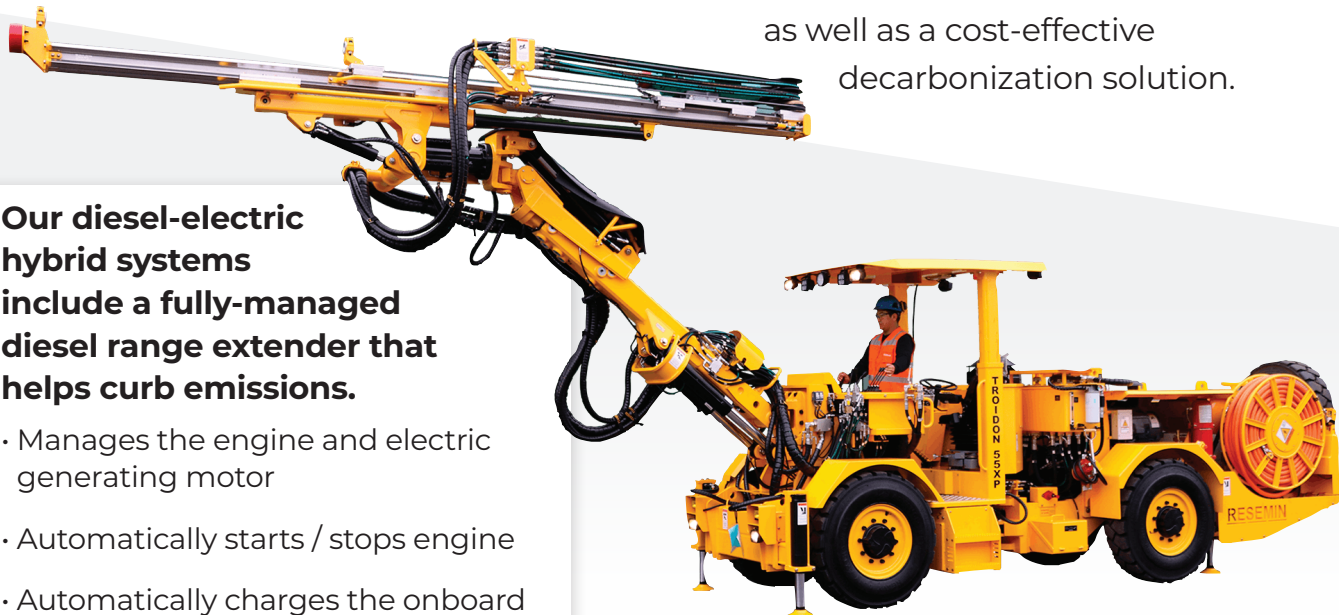


Customers often come to us with a machine and a duty cycle in mind. We recommend a Feasibility Study to help develop an EV solution that will exactly suit the vehicle and its duty cycle. Studies also point the way to meeting emissions-reduction objectives.



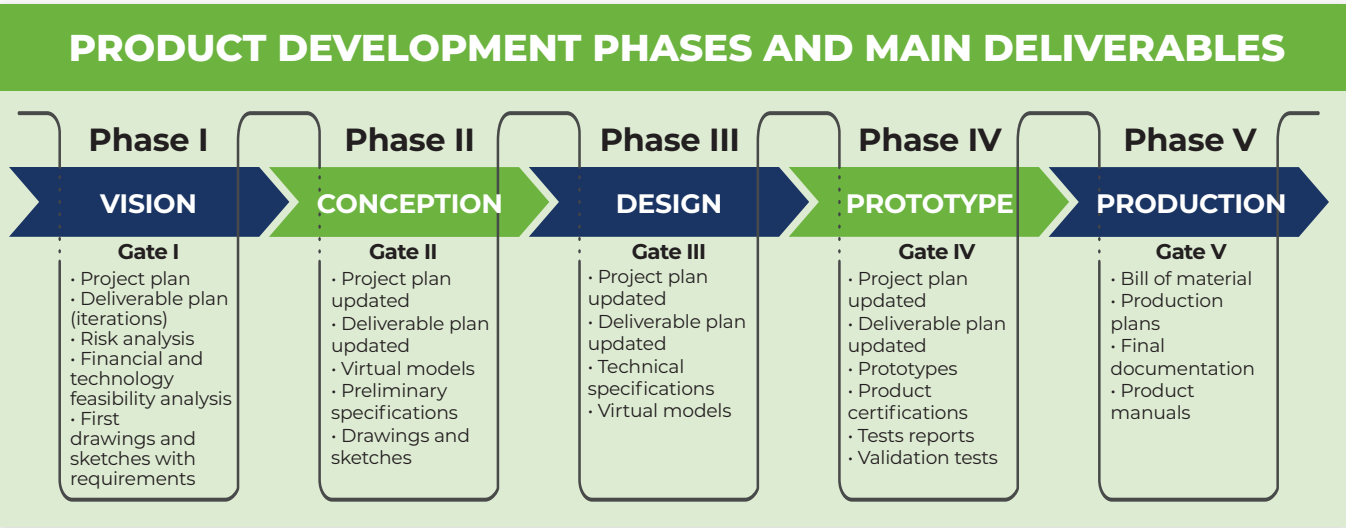
# BATTERY-ELECTRIC & DIESEL-ELECTRIC HYBRID CONVERSIONS

Industrial vehicles may have more than one engine change during their lifecycles. Converting current fleet vehicles from diesel to pure battery-electric or hybrid diesel-electric is a popular option for quick-turnaround vehicle electrification, as well as a cost-effective decarbonization solution.



- Our diesel-electric hybrid systems include a fully-managed diesel range extender that helps curb emissions.**
- Manages the engine and electric generating motor
  - Automatically starts / stops engine
  - Automatically charges the onboard battery system
  - CAN J1939-controlled for easy integration

**We approach electric conversions the same way as we approach all electrification projects:**



# ELECTRIFICATION FEASIBILITY STUDIES

Vehicle & Fleet Electrification Feasibility Studies start by mapping out vehicle duty cycles. They finish with specific powertrain, battery and charger recommendations, a breakdown of anticipated emissions reductions, costs, and savings over time versus diesel. A feasibility study is the recommended first step in electrification.

## Sophisticated modeling software

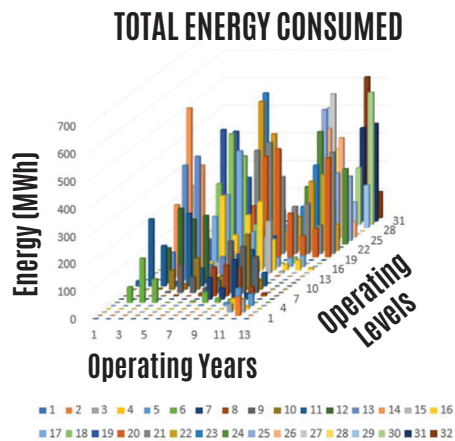
Electric Vehicle Fleet Optimization Software (EV-FOS) optimizes battery-electric vehicle energy usage for new and existing mines. It clearly shows the effectiveness of battery-electric compared to diesel, as well as optimal battery size and charging infrastructure. Get dollars per tonne by level, by year, for fast charging, battery swapping, and diesel.

## Calculating Costs & CO2 Reduction

Our recommendations can include vehicle size for most efficient operation, battery chemistry, and charging technology. We calculate energy costs (diesel versus electricity) specific to your operation, as well as significant additional maintenance savings.

We calculate the reduction in CO2 emissions and annualized carbon tax savings for your jurisdiction. We do a side-by-side cost-of-ownership analysis (diesel versus electric vehicles) in cost per tonne (or other metrics) and total savings.

MEDATech electrification feasibility findings are the result of the best electric vehicle models in the world. We are confident that the result of our Vehicle & Fleet Electrification Feasibility Studies will provide you with an efficient path forward for electrification.



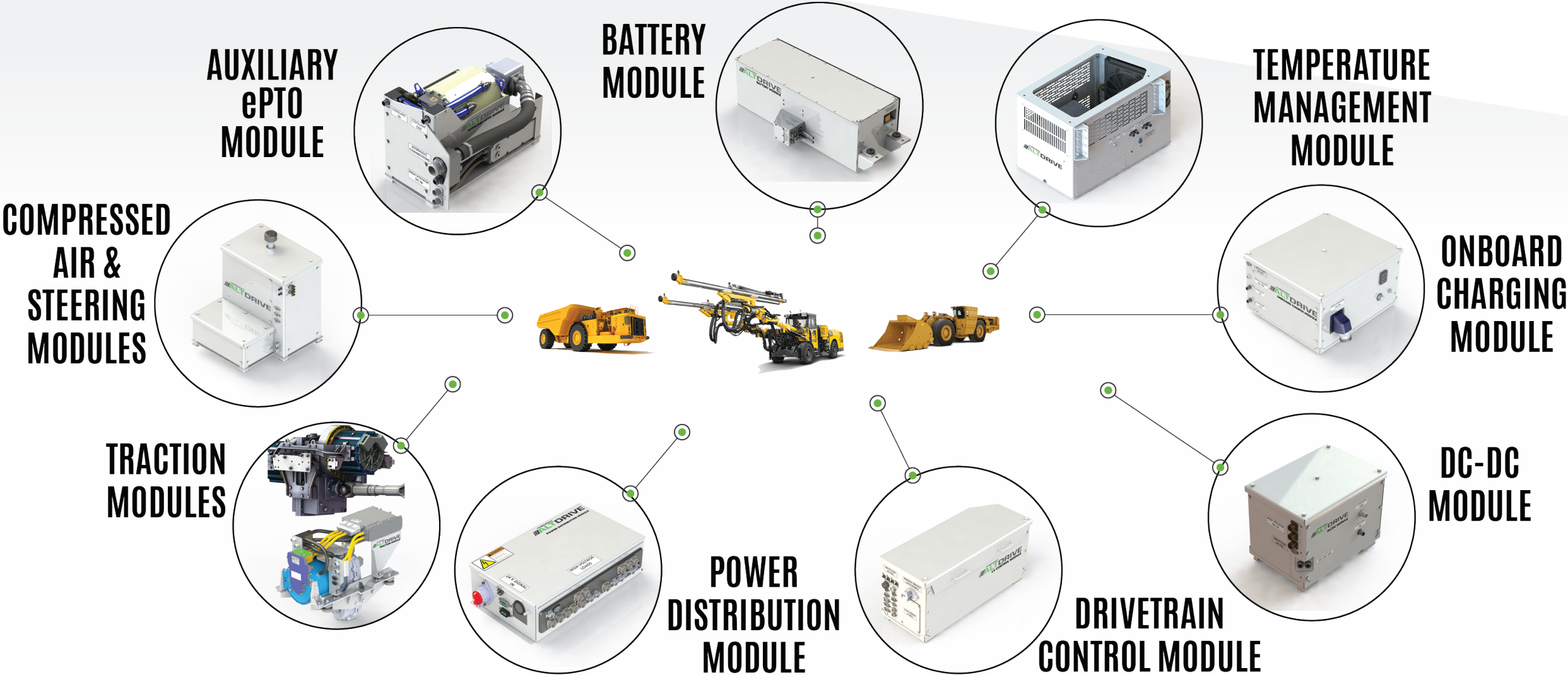
## FEASIBILITY STUDIES PROVIDE A CLEAR UNDERSTANDING OF:

- True cost of production
- Vehicle / fleet sizing to meet productivity goals
- Energy mapping & costs
- Charging requirements & placement
- Carbon footprint improvements
- Total costs over life of site (or of a single vehicle) versus diesel



# BATTERY-ELECTRIC POWERTRAIN KITS

We provide battery-electric powertrain kits and software for heavy-duty mobile equipment. Applications range from side-by-side personnel carriers to 100-tonne surface haul trucks. ALTDRIVE battery-electric powertrains are composed of the most reliable, durable components available. Each one is specifically sized for each machine and what it needs to accomplish.



## PRE-ENGINEERED MODULES

Components are pre-assembled into sub-systems and configured specifically for your machine, then tested. This reduces installation/commissioning costs and optimizes system effectiveness. Once you place modules on your machine and adjust the lengths of electrical harnesses and hoses between them, you can plug into the J1939 CAN network and begin vehicle commissioning.

## TRACTION

The traction module consists of a traction motor or motors, inverter and gearbox. The motors and inverter are pre-wired, and the coolant connections are manifolded to ensure optimum coolant flow to both motors and inverter.

## CHARGING & STORAGE

The battery module is made up of individual sub-packs, battery disconnect units, master battery controller, thermal control manifolds, high-voltage connections, mid-pack disconnect, and low-voltage connection and communications. All connections are well-engineered and simple to connect. Onboard charging modules are optimized for machine duty cycle and installed battery capacity, with a single interface controlling multiple onboard charger units.

## POWER MANAGEMENT

The power management module distributes high-voltage DC power to the traction module and all other high-voltage loads. It is engineered for safety and isolation.

## THERMAL MANAGEMENT

The thermal management module consists of an active loop (chiller / heater units that keep batteries within a tight, optimal temperature range) and a passive loop (radiator-based, supplies all other high-voltage components).



# CHARGING TECHNOLOGY

Choice of charging technology depends upon the vehicle, its operating environment and duty cycle. We can perform an analysis and supply the charging solutions best fit for your application. Options include onboard charging, plugging in anywhere that 3-phase AC power is available; offboard DC fast charging; and fully-automated offboard ultra-fast DC charging.

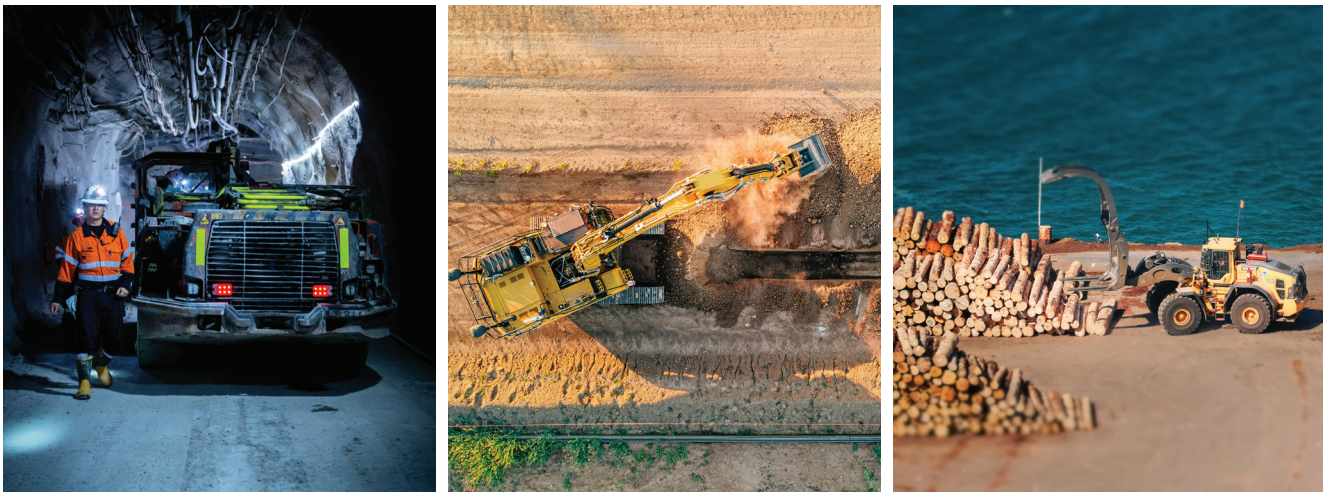


High-power offboard chargers



Onboard chargers

# ELECTRIFICATION CONSULTING



Miners, construction firms, forest products companies and other heavy industries have a mandate to reduce emissions, but also to run profitable operations. Great progress has been made, but there's still no clear path to financially-positive fleet electrification.

Electrifying a fleet is not as simple as swapping diesel vehicles for battery-electric vehicles and chargers. Grid, load balancing, shift adaptation and other factors are at play. The broader electrification ecosystem must be taken into account.

FACTORS IN PREDICTING FLEET PERFORMANCE

- Drivetrain
- Charge Power
- Fleet Management
- Grid Power & Impact on Performance / Productivity

## FLEET TRANSITION PLANNING

MEDATech is a world leader in high-fidelity vehicle modeling. That's the first step in planning a fleet transition from diesel to battery-electric. Together with our partners, we can model your ecosystem and provide a complete solution that will help you to meet not only your decarbonization and health & safety goals, but also your financial and production goals.



# THE MINE ELECTRIFICATION ECOSYSTEM

MEDATECH  
ALDRIVE

PUBLIC GRID

CLEAN ENERGY

POWER QUALITY STABILIZATION

ENERGY STORAGE

ALDRIVE POWERTRAIN

CHARGING

BATTERY SWAPPING

TELEMATICS DATA

ROUTING

CHARGING  
SCHEDULE

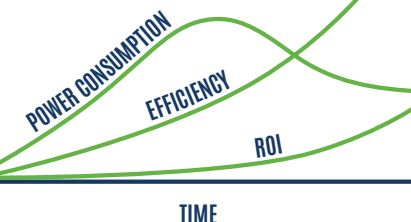
FLEET  
OPTIMIZATION

MAINTENANCE

TRAFFIC  
MANAGEMENT

POWER  
MANAGEMENT

FLEET OPTIMIZATION



## POWER SOURCE & STORAGE

Grid power may be supplemented with local power from renewable sources, and power storage can help manage peak demands.

## ENERGY FILTERING & CHARGING

High-power charging requires electricity with a high level of power and voltage quality and stability.

## ALDRIVE POWERTRAIN

Our powertrains are efficiently configured and sized to suit the exact job that a vehicle is required to perform.

## TELEMATICS DATA COLLECTION

Operating data collected from vehicles and chargers yields a detailed record of performance, enabling good decisions.

## FLEET OPTIMIZATION

Analysis of vehicle data results in the insights required to optimize routing, power management, traffic management and other variables.

## EXPECTED RESULTS

Continuous optimization and ever more sophisticated equipment, infrastructure and processes will reduce power consumption, drive efficiency and provide ROI as the mine becomes fully electrified.



# TECHNICAL CAPABILITIES

From high-fidelity EV simulation to in-house software and vehicle management unit design, to every aspect of building a vehicle, we handle the entire vehicle-electrification process.

## SERVICES



## CAPABILITIES

### Project Management

Complete project management, with seamless integration to OEM/supplier project teams. Can include testing & validation support for the complete vehicle.

### Battery Packaging

Battery packaging at the vehicle level, or battery module integration, plus high-level integration support and testing.

### Electrical & Mechanical Engineering

From schematics & panel design to component selection, mechanical/hydraulic engineering and 3D modelling to structural analysis and functional safety implementation.

### Human Machine Interface (HMI)

Design, build and test HMIs, including displays and gauges.

### Vehicle Management Units (VMU), Cab Controls & HVAC

Design and program vehicle controllers and control systems.

### Vehicle Analysis

Simulate EV performance, carry out integration engineering and build prototypes. Develop customized simulation software to understand clients process and vehicle performance needs.

### EV Software

From in-house software design to drive power energy requirements to high-voltage distribution, battery and motor efficiencies, to virtual testing and validation.

### Telematics

Complete data analysis solutions, from in-house Graphical User Interface (GUI) development to advanced cloud-based analytics and modelling. Advanced visualization tools help you review expected machine data.

### System Design

From consulting and software development to full system design and prototyping, we use model-based design and simulation (MATLAB / Simulink), CAN-based control system engineering as well as our knowledge of functional safety systems & standards to provide complete, state-of-the-art solutions.

### Commissioning & After-Sales Service

Commissioning worldwide, as well as ongoing after-sales service and planned upgrades, both remotely (software) and on-site.

## A TRUSTED PARTNER

Want a partner for life? MEDATech designs, builds and delivers what we promise. We also maintain and upgrade heavy-duty mobile equipment, both our own and OEM machines, worldwide.

As a result, we have customer relationships that stretch back 20 years or more: mining and exploration companies, utilities and construction firms who turn to us when they need equipment that's faster, safer, more durable and better for the environment.

In a world of here-today-gone-tomorrow, ALTDRIVE stands alone. From British Columbia to Australia, our team is only a flight away. We are with you, for your entire journey.





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## BATTERY-ELECTRIC POWERTRAIN SOLUTIONS

FOR HEAVY EQUIPMENT

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**Serving Customers Worldwide**