LEVELING-UP CONSTRUCTION EQUIPMENT WITH ELECTRIC POWER

Electrification is the future. Companies can reap the benefits by beginning the transition now.

The global construction market is growing and is expected to increase rapidly over the next several years. In 2019, the market size was 129.32 billion USD and is projected to reach 160.84 billion USD by 2027.

Global market growth can be attributed to two primary drivers:

1. Public-private partnerships are increasing construction activities and boosting government investments in infrastructure.
2. Global companies are focusing on R&D to deliver more efficient equipment for industries and end users.

Changing consumer demands and environmental priorities are also having a heavy influence on the state of the construction market. For instance, end users and original equipment manufacturers (OEMs) worldwide are seeking more fuel-efficient and technological savvy fleets that will augment construction activities and reduce operating costs.

It's well documented that the construction market is the biggest driving factor of ozone emissions and a contributor to deteriorating air quality. To curb this trend, countries, including Canada, the U.S, China and those in the European Union, are taking steps to reduce the effects of global warming through stricter emission regulations.

While future regulations may force manufacturers to transition all equipment to electric battery powered systems, companies can get ahead of the curve and drive market leadership by electrifying their equipment and vehicles early.

Three Drivers of Increased Electrification

Driver #1: Significant improvements in lithium battery technology

The total cost of ownership of electric models can be lower in comparison to diesel-powered models. Diesel models are subject to gas price fluctuations and high maintenance costs. The progress being made around energy density in battery technology, specifically lithium batteries, allow manufacturers to get more energy for the same volume, or the same energy capacity at a lower price – both compelling factors when working to maximize battery lifespan and reliability. Moreover, electric machines eliminate fuel storage issues and have less engine service requirements, which is an important price factor when assessing overall costs.

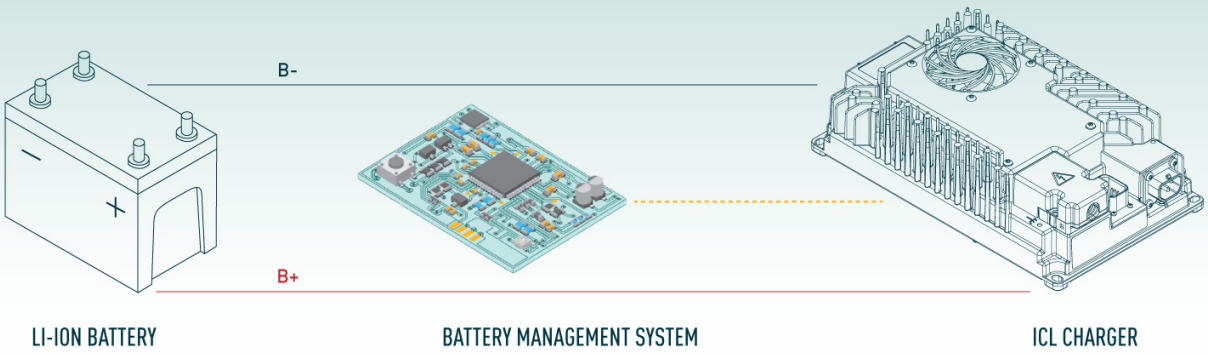
Historically, the battery technology market was dominated by lead-acid batteries, which did not offer the same longevity in the field as diesel-powered equipment. The invention of lithium batteries closed the power gap which made the switch an attractive option for equipment manufacturers, except for the high costs. These costs are dropping at a predictable rate as lithium battery technology continues to advance and adoption increases.

The most noticeable benefit of lithium batteries, compared to traditional lead-acid batteries, is that they reduce maintenance needs and costs for equipment. Lithium batteries are also always sealed, so they do not require watering. The combination of these two elements can help ease concerns about acid corrosion and shortened battery life.

Since lithium batteries are three times smaller and four times lighter than similar lead-acid batteries, the same amount of energy fits into less space, enabling superior performance. The energy density of lithium batteries also enables the machines to run longer, increasing performance by as much as 40 percent. Additionally, lithium-ion batteries are faster and more efficient to charge.

Lastly, the longer lifespan of lithium batteries reduces the costs associated with equipment upkeep, allowing organizations to invest money elsewhere. Leading lithium batteries deliver a 2000+ charge cycle lifespan, providing additional years of operational use as compared to traditional batteries. In many cases, these lithium batteries last as long as the machine in which they are installed.

View **this infographic** to discover the benefits of lithium batteries.



Driver #2: The reduced complexity of electrification compared to traditional powered engines

The simplicity of battery-electric vehicles compared to their internal combustion counterparts offers a plethora of benefits. Tesla veteran, Dustin Grace swears by battery powered electric vehicles (EVs) and argues that EVs have better torque at low speeds, while diesel or gas engines need help from a transmission to generate motion. In the construction industry, where equipment is traveling at lower speeds, it's critical to make note of this agility benefit. Without complex gears and fluids of a transmission, electric alternatives are more efficient and agile.

Other benefits of battery powered systems relating to reduced complexity include:

- Design flexibility and cost: Governments worldwide are implementing stricter emission regulations on vehicle and non-road mobile machinery manufacturers, such as the EU Stage V Emissions Regulation, China VI Emission Standard, and USA EPA Tier 4. These regulations are aimed at helping the UN Intergovernmental Panel on Climate Change's goal to cut global carbon emissions by 45% by 2030, and to zero by 2050. Design updates to meet these regulations would not be as straightforward. Machines less than 56kW would require many additional parts – such as particulate filters and portable emission measurement systems – which can be very complex and costly. Transitioning to hybrid or battery-powered vehicles is simpler and cheaper in the long-run.
- Straightforward service: Electric vehicles are easier to service because there are fewer subsystems. Due to not having transmission, oil tanks or catalytic converters, there are fewer systems that can break down. Further, in an electric drive train, the motor is much smaller and requires a smaller team to build.
- Go-To-Market Timeline: There is a shorter product planning cycle for electric equipment, which allows companies to design more machines in a reduced period.

Driver #3: Telematics

Telematics and automation are emerging trends in most equipment industries. As automation becomes more of a reality, telematics can enhance electric batteries, while the ability to gather data can improve battery life and equipment performance in a larger fleet.

Telematics technology is continuing to evolve and provide equipment owners with more insight. The components in the machine collect a wide range of information and can alert the user of a potential issue before it occurs, which reduces repair and labor costs.

Further, operator performance data allows users to track the performance of the vehicle and identify bad habits such as idling time or poor charging practices. Smart battery chargers, such as Delta-Q Technologies' (Delta-Q) chargers, track a wide range of charge data such as voltage, current, temperature and consistency of usage. This intelligence helps inform and improve future usage and purchase decisions.

For electric vehicles, Delta-Q's smart battery chargers can "talk" with all the components in the machine and integrate with the fleet management solution using CAN communication protocols. This helps notify users when the battery needs to be charged and if there are any battery failure issues. If problems arise, the machine will log the information so the engineers can diagnose the problem and solve it.

For enhanced safety and security, Delta-Q's software uses CAN communication protocols to create encrypted key exchanges, which authenticates the charger for its assigned machine/battery pack. This prevents unauthorized chargers from unsafely charging any lithium system.

Alternate Options to Gas- and/or Diesel-Powered Equipment

With the benefits of electric vehicles and machinery clear in mind, let's look at a few electric alternative's OEMs can choose from that aligns with their current budget, needs and customer requirements.

Battery-Electric Vehicles

Battery powered electric vehicles function with an electric motor driving the wheels or hydraulics; and a motor controller managing the torque and rotational speed of the motor with DC power from the battery packs. There are no internal combustion engines, fuel cell or fuel tank, which increases ease of design and use.

Today we are seeing fully electric machines in use for lower powered applications. Low-powered electric vehicles are well-established in golf carts, scissor lifts, aerial work platforms and floor care machines.

We are continuing to see some OEMs release fully electric versions of compact construction equipment. Here are a few examples of companies and equipment manufacturers that have exciting prototypes and fully electric solutions on the market.

- Bobcat E10e Compact Excavator: Bobcat's E10e Compact Excavator is designed for easier maintenance, safe operation and near silent. The excavator has a state-of-the-art lithium, maintenance-free battery pack and advanced battery management system.
- Volvo's EC424: Volvo CE brought its ECR25 Excavator to market as a solution that uses electric battery to enhance performance within a compact package.
- Case 580EV: The first fully electric backhoe loader was brought to the market in March 2020 by Case. The 580 EV brings the same power and performance as its diesel counterpart, while also reducing noise, operating costs, and maintenance demands.

As battery technology evolves, we will see more equipment manufacturers leverage lithium battery technology for their larger construction machines. This will enable the design of more compact applications that lower operating costs, reduce maintenance requirements, increase durability and boost overall reliability.

Hybrid Electric Vehicles

Another alternative to gas- or diesel-powered equipment are hybrid electric vehicles. These machines use both an internal combustion engine (ICE) and an electric motor to obtain maximum power and fuel economy, with minimum emissions, and manage the range or operation time expectations.

Hybrid electric vehicles are a great option for higher-power applications that cannot exclusively rely on electric solutions because of high peak power demands or long operational uptime requirements. Hybrid electric systems offer the best of both worlds, the option for petroleum power and quiet operation.

A few of the hybrid electric vehicles that have come out in the market include:

- John Deere's 944K wheel loader: This solution is a hybrid-electric production-class loader that helps maximize productivity and efficiency. The company has over a century of delivering products and services for agricultural, construction, and forestry machinery, diesel engines, drivetrains used in heavy equipment, and lawn care equipment.
- Kobelco's SK850 excavator: This solution is driven by electric power that cuts fuel consumption by 15 percent. Since 1930, Kobelco has been innovating its industry-leading excavators to create equipment that meets the needs of tomorrow.

Range Extenders

Another option, in addition to hybrid electric vehicles, are range extenders. These tools expand the vehicle's range when the batteries are depleted. Range extenders are similar to hybrid vehicles except the ICE does not drive the vehicle, it only adds electrical power to the electric or battery system. Commonly used range extenders are small internal combustion engines; however, micro turbines and hydrogen fuel cells are used on a few automotive products.

Range extenders are for applications that need longer runtime than offered by current battery technology. It is also intended for machines used at rural locations without access to power outlets or charging stations. Examples of industries include forestry and marine.

Getting Started

Given the rising prominence of electric equipment, companies will have a range of choices that can handle the toughest construction jobs—all while delivering more efficiency and reduced cost of ownership.

Before starting your journey on choosing which electric system is best for your machinery, we have provided a list of steps (see right) to help you determine what type of electric option is best for you and your customers. After following these steps, you will be well-positioned to make informed choices for your next investment in the future of electric equipment.

Our team at Delta-Q is happy to guide you through the electrification process and answer your questions. If you are interested, **book a consultation call with our team here**.

Step 1: Identify Your Target User: Are you making equipment for rental companies? Construction workers? Contractors?

Step 2: Define Machine Requirements: Where is the machine being used? Inside, outside, or both? How long does the machine need to last for? Are there any regulations you need to meet?

Step 3: Hybrid or Fully Electric: After identifying the machine requirements, consider whether hybrid or fully electric is more suitable for your needs.

Step 4: Component Selection: Identify and source a traction motor, controller, battery type and brand, and charger. It can be beneficial to work with a full solution provider or choose component suppliers that work well together or have a good reputation for reliability. Ensuring all components work well together is important for creating a successful electric machine.

Step 5: Identifying Load Profiles: Identify usage conditions and whether the design and battery capacity can meet the performance of the similar ICE or diesel power source.

CHOOSING THE RIGHT SOLUTION PROVIDER

It is critical to find the right suppliers that work cohesively to avoid any component failures. **Delta-Q Technologies** specializes in battery charging solutions and is part of the **ZAPI Group Inc.** of companies, which is a full-solution supplier. With our partners, we can support every component you need to design effective electric vehicles, such as controllers, motors, and battery chargers, that meet cost goals and comply with tightening environmental standards.

Our team of experts are here to help you answer tough questions and understand the capability of each electric drive component, so that you can build an electric solution with better flexibility and longevity than traditional gas or diesel options.

To learn more, book a consultation call with our team here:

CONSULTATION

About Delta-Q Technologies:

Delta-Q Technologies develops and supplies battery chargers to original equipment manufacturers (OEMs) of electric vehicles and industrial equipment. Delta-Q's unique blend of engineering capability in high efficiency power electronics and embedded software design delivers innovative battery charging solutions to meet the evolving needs of its customers. With more than three million vehicles and industrial machines already using its products, Delta-Q's innovation is enabling the widespread adoption of environmentally friendly electric drive systems. Delta-Q was founded in 1999 and is a privately held company located in Vancouver, Canada. Please visit **www.delta-q.com** for more information.

About ZAPI Group:

The ZAPI Group is a leader in in motion control for battery and hybrid-powered vehicles. We offer a range of low and high voltage inverters, battery charging systems, DC/DC converters, master controllers, displays, joysticks and custom AC and permanent magnet DC motors covering battery voltages from 12V to over 700V to satisfy a wider range of industrial off-highway, construction and agricultural vehicles and equipment. The ZAPI Group stands ready to provide products and support for your engineering development at every step from initial prototype design to production release. We can expertly specify the entire electric vehicle integration thus ensuring that the vehicle performance and efficiency targets are met. Visit **www.zapigroup.com** to learn more.

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