



Lightning Systems Company Background

Lightning Systems designs and manufactures zero emission all-electric powertrains for medium- and heavy-duty vehicles, including delivery trucks, shuttle buses, passenger vans, chassis-cab models, and transit buses. Lightning's product range includes elegantly integrated all-electric powertrains for the Ford Transit 350HD passenger wagon and cargo Van, Ford E-450 shuttle bus and cutaway models, Ford F-59 step/food van, Ford F-550 cargo trucks and buses, Chevrolet 6500XD Low Cab Forward model, and 30-foot, 35-foot, and 40-foot transit buses. Every vehicle is equipped with Lightning Analytics, which is an in-depth data capture and analysis system which allows fleets to optimize their operations.

In September 2019, Lightning Systems added a line of charging stations to its portfolio, making it easier for fleets to transition to electric.

The Lightning team works with forward-thinking fleets to provide the right electric powertrain on the right chassis in the right drive cycle. Lightning's products improve a fleet's operating costs and safety, and make sure they are driving the cleanest and most advanced technology available. Based in Loveland, Colorado, the company has offices in San Francisco and San Diego. Our Loveland facility includes a full production floor and resources for new product development and testing.

We're passionate about the environment *and* fleet efficiency. We believe that you can have both, and our products are meticulously and intelligently designed to deliver.

Product Design Approach

Some commercial EV manufacturers adopt the approach of building completely new vehicles from the ground up. Lightning Systems believes that this approach is expensive and commercially unsustainable, and has adopted the approach of creating electric drivetrains for existing, well-established vehicles which have strong parts, support and service ecosystems already in place. For example, there are established vendors of shelving, cargo lifts, wheel-chair lifts and other accessories for vehicles such as the Ford E-450 and Transit vans. By working closely with dealers, the Lightning Systems electric drivetrains are installed before the vehicles are registered with their end users, and are therefore regarded as new vehicles. In the case of Ford, our status as a member of Ford's eQVM program means that Ford's vehicle warranty is in full effect, covering everything except the drivetrain, which is covered by Lightning's warranty.

Architecturally, the Lightning Systems electric drivetrains are designed to replace the vehicle's diesel or gasoline engine and transmission in such a way that the vehicle is propelled through its existing drive shaft. This approach makes upfitting quick and relatively simple. However, our integration goes much further by ensuring that the driver's environment and driving experience are both familiar and polished. For example, the dials on the dashboard are updated to reflect the vehicle's electric operation, and

vehicle creep is implemented to make slow-speed maneuvering easy and safe. Our vehicles implement a sophisticated power regeneration feature which captures braking energy in the form of battery charge, which increases the vehicle's overall efficiency.

A major component of the drivetrain is the batteries. Unlike many of our competitors, who select the lowest-cost battery cells available, we use cells from tier 1 manufacturers, which ensures better quality and longevity. In addition, and also unlike most of our competitors, we implement intelligent active thermal management for our batteries to keep them operating in their ideal temperature range. This improves performance, range and efficiency while dramatically improving battery lifetimes from just one or two years to as many as 10.

Target markets

Because Lightning Systems' products include both cargo and passenger vehicles, our customers' businesses are wide-ranging. Delivery companies – or delivery operations of product or retail companies – are one of our largest target markets, because electric drivetrains are well-suited to urban delivery routes where zero-emissions operation is important, and where daily route lengths fit comfortably within the on-road ranges of our electric vehicles.

Passenger shuttles, such as at airports, campuses and paratransit, are also a target market, with passengers benefitting directly from the quiet, emissions-free vehicles. Finally, we also offer "Repower" kits, which are conversions for older diesel transit buses to fully electric. These are a much cheaper way for a city to replace polluting diesel buses than buying new, purpose-built electric buses.

Regulatory certifications and incentives

Lightning Systems makes it a priority to have all of its vehicle drivetrain products certified by CARB for sale in California, and approved for governmental financial incentives such as California's HVIP and New York's NYTVIP programs. For some vehicles, such certification requires third-party dynamometer testing to confirm vehicle ranges under industry-standard drive cycles which are representative of commercial driving activities. Our range estimates are based either directly on such dynamometer testing, or on sophisticated modelling derived from dyno data. This allows fleet operators to have confidence in our range estimates.

Environmental

The on-road benefits of electric vehicles are obvious: zero emissions of CO₂, CO, NO_x, soot and VOCs. However, the full environmental footprint of an electric vehicle is more nuanced and depends considerably on the "grid mix" of the electrical supply. For example, an EV's operation has a higher carbon footprint in a coal-powered region than it would if wind and solar are major components of the mix.

For a more in-depth look at the environmental impact of our vehicles, read [this article](#).

Company history

Lightning Systems was founded (as Lightning Hybrids) in 2008 to design a vehicle to compete in the 2010 Automotive X Prize for a highly efficient sports sedan. The approach taken was to equip an existing gasoline vehicle's drive train with a hydraulic hybrid regenerative braking system. Abandoning the

passenger car concept as too expensive to bring to market, the company focused on developing the hydraulic hybrid system as a retrofit product for trucks and buses. While the technology was effective and innovative, market adoption was slow, so the company turned its attention to electric drive trains in 2017, renaming to Lightning Systems in the process. With the rapidly growing market for EVs world-wide, the opportunities are much greater.

Product development was rapid, with the aid of key partners and suppliers, and Lightning's current product range is among the best performing, best engineered and most reliable in the market.