

ELECTRIC VEHICLES MADE WITH ALUMINUM COST LESS, GO FURTHER



“Many of the current hybrid vehicles are progressively adding lower weight components to improve overall vehicle performance. When it comes to making electric vehicles more affordable and efficient, aluminum is proven to get you there with no compromises.”

Randall Scheps – Chairman
The Aluminum Association’s
Aluminum Transportation Group



KEY TAKEAWAYS

- ▶ \$3 in battery cost savings per \$1 invested in electric vehicle weight reduction
- ▶ 10 percent weight reduction yields 4-6 percent reduction in battery size
- ▶ By reducing the mass of the vehicle by 20 percent, the vehicle’s range can improve by up to 20 percent

President Obama has called for a one-third reduction in oil imports by 2025 and wants to put 1 million plug-in electric vehicles (EVs) on the road by 2015; however consumers continue to express anxiety over electric vehicle range and their increased cost. Researchers are working on improved battery technologies to increase driving range and decrease recharging time, weight, and cost as it is widely believed that these factors will ultimately determine the future of EVs.

With this in mind, the Aluminum Association along with Ricardo, an independent consulting firm, evaluated the impact of vehicle weight reduction on electric vehicle performance, range and battery size. This study demonstrates that by upgrading from traditional steel to an advanced aluminum body structure, the vehicle’s stored energy requirements can be cut by about 10 percent, which could save up to \$3,000 per vehicle since less power is required to move the lighter vehicle..

STUDY FINDINGS

- ▶ Aluminum use in electric vehicles can yield a savings of up to \$3,000 per vehicle.
- ▶ The driving range of the vehicles could be improved approximately equal to the mass saved. That is, reduce the mass of the vehicle 20 percent, go 20 percent further.
- ▶ Regenerative braking could recover about 65 percent of the energy associated with the vehicle’s momentum irrespective of the vehicle weight; however, this is only about 15-20 percent of the total energy expended.

METHODOLOGIES

Ricardo used previous data from a vehicle weight reduction study on fuel economy for light-duty vehicles to modify the small car and SUV models for EV operation. The Federal Emission Test Procedure, FTP75 was used to size the initial electric powertrain to achieve a 40 and 80 mile ranges. The study also reported the range based on the Highway Fuel Economy Test (HWFET) cycle and 45/70 mph steady-state operation. The baselines for EV performance [0-30 mph, 0-60 mph] were kept comparable to the initial conventional vehicle.



The electrical powertrain weight was computed and deducted from the original conventional powertrain for each iteration. The vehicle structural weight was updated based on the new powertrain mass and size, according to the Aluminum Association's structural weight computation. The electrical powertrain was then re-sized iteratively to keep range constant at similar performance.

CONCLUSIONS

Real world designs already support the fact that lightweight structures are a significant enabler for improving electric vehicle range and breaking down cost barriers. Examples include Tesla Motors's Roadster and Fisker Automotive's luxury vehicle; both of which use lightweight aluminum platforms.

An aluminum-bodied electric vehicle or hybrid would be less costly overall than a steel-bodied version of the same vehicle because fewer heavy/expensive batteries would be needed for the lighter vehicle. As advanced powertrains come online, with their added costs, (and weight) the value proposition for low-weight, yet high-strength, aluminum grows and can be more competitive overall than steel.