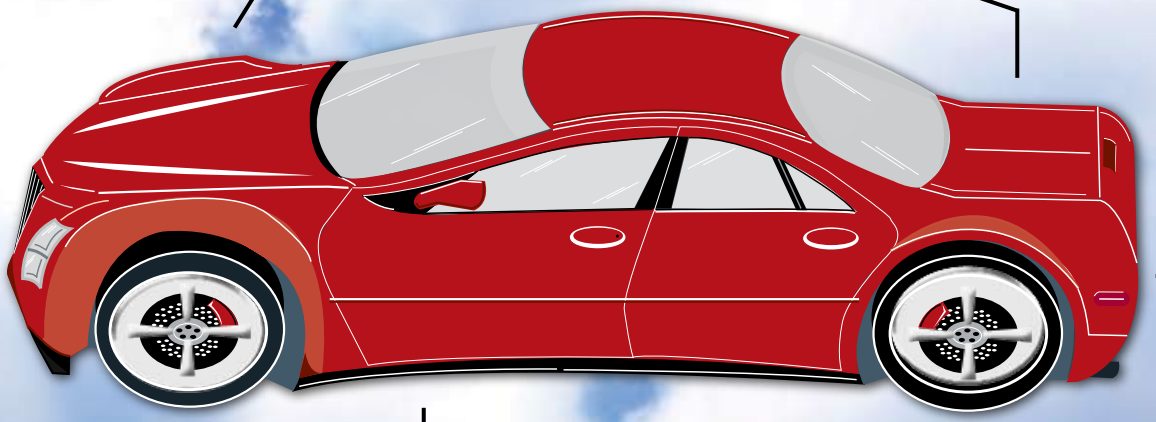
# Composites Make Sense for Hybrids

**Front/Rear Bumper Beam Supports**
- 30% - 40% mass reduction

**Hood**
- 30% - 40% mass reduction
- 60% - 70% lower tooling investment

**Deck Lid**
- 25% - 35% mass reduction
- 50% - 60% lower tooling investment

**Rear Trunk Compartment**
- Up to 50% mass reduction
- Up to 70% lower tooling investment



**Front/Rear Fenders**
- 25% - 35% mass reduction
- 55% - 65% lower tooling investment

**Underbody Structure**
- 30% - 40% mass reduction
- One-piece with 50% - 60% lower tooling investment

**Battery Module**
- Composites non-conductive, safer

**It's a fact:** No other material comes close to composites for reducing weight while simultaneously lowering investments in automotive components, and those are key reasons why they're especially suited for hybrid vehicles. Hybrids combine battery power and liquid-fuel engines, so every pound saved conserves the batteries and fuel, meaning greater overall energy efficiency and operating range.

Composites have many other advantages, such as opportunities for parts consolidation and structural robustness, styling innovations, reducing cabin noise and providing thermal insulation.

Hybrid cars and light trucks are forecast to exceed one million in sales annually by 2012. To demonstrate its case, the Automotive Composites Alliance (ACA) recently benchmarked a prototype of a future hybrid sedan to closely measure how composites can play a major role in hybrid development programs.

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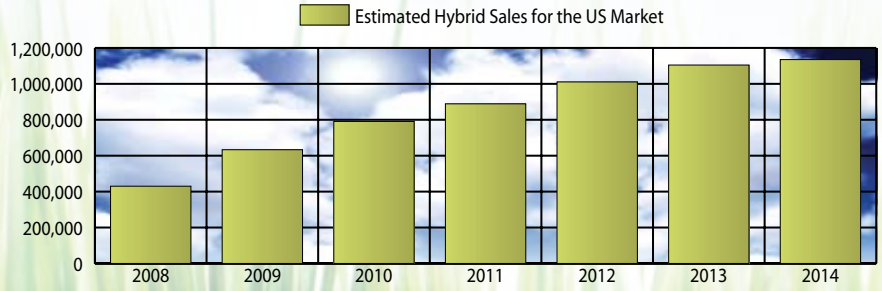
## Hybrids Forecast to Top One Million by 2012




Source:
J.D. Power and Associates

# Benchmarking Composites in Hybrids

## Hybrids Forecast to Top One Million by 2012

*Continued from front page*

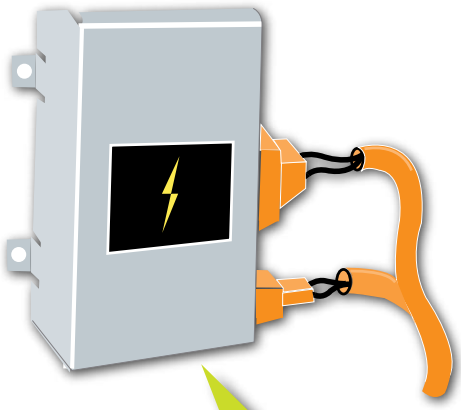
The ACA targeted seven applications: battery modules; front cowl-to-rear axle underbody floor pans; hoods; fenders; deck lids; trunk compartments; and front and rear bumper beam supports.

"We said 'Let's look at exactly what we can do,'" says David Dyke, advanced engineering manager at Meridian Automotive Systems. "We disassembled the car, weighed and measured components and discovered a lot of opportunities for mass savings."

Dyke and Jeff Bates, program engineering manager, Molded Fiber Glass Companies, also calculated savings in tooling investments and opportunities for corrosion and NVH improvements. Bates' examination of the vehicle's steel underbody elicited major benefits by replacing numerous steel parts with a one-piece molded composite. "We think we can also improve cabin acoustics and stiffness by making a sandwich using a formable core – possibly balsa," he says.

Specific results of the ACA's hybrid benchmarking project are presented on these pages and reveal significant mass and cost savings, mileage improvements and opportunities for model differentiation.

## Composites Ideal for Battery Modules

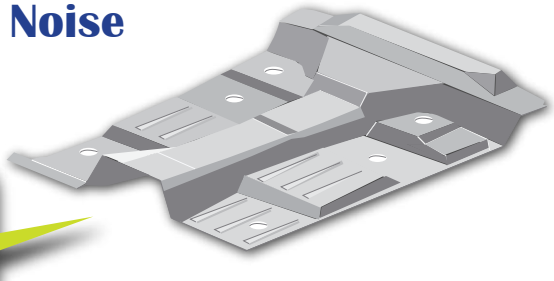


*A two-piece composite reduces weight and tooling costs vs. metal stampings.*

Battery modules contain the battery pack, electronic controller and wiring harness, and in the U.S. typically are fabricated of numerous metal stampings.

Composites make it possible to reduce the module to a two-piece molding with major mass and tooling investment savings. Unlike metal, composites don't conduct electricity, therefore providing an extra safety advantage. They also won't corrode and allow integrated airflow cooling in the module's tunnel, all adding to longer battery life.

## Composite Underbody Floor Pan Adds Stiffness, Reduces Noise



*Parts complexity is sharply reduced by consolidating all pieces into a single composite molding, meaning easier assembly.*

Stretching from the front cowl to the rear axle, a vehicle's underbody, or floor pan, is a large structure measuring 40 to 45 square feet and is typically constructed of numerous steel stampings welded together.

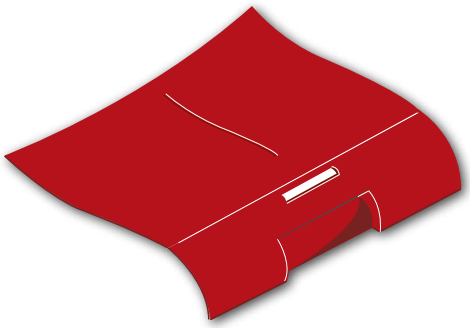
Using a lightweight core in a single-sandwich mold, mass can be reduced 30% - 40% with tooling investment savings up to 50% - 60%. Attributes include additional stiffness and sound deadening, which provide a better, more comfortable ride.

## Complex Trunk Structure Reduced to Single Molding

- *Mass lowered 50%*
- *Tooling cut 70%*

ACA research indicates that using structural low-density composites in a one-piece molding can reduce mass up to 50% in trunk compartments.

Composites would replace six to eight metal stampings in the complex geometry of the trunk at a savings of up to 70% in tooling investment.



- *Mass reduced 25% - 35%*
- *Tooling investment reduced 50% - 60%*

## A Composite Hood Cuts Weight and Tooling Costs

ACA compared a composite hood with a steel hood for the benchmarked vehicle. The result was a significant 30% - 40% savings in mass. Importantly, it was determined that tooling investment could be reduced 60% - 70%.

"The total cost is always cheaper overall for composites in volumes under 125,000," says Meridian's David Dyke, adding that the day of high volume output of a single model line has virtually ended as the majority of the market splinters into niches.

- *Mass reduced 25% - 35%*
- *Tooling investment reduced 55% - 65%*

## Four Parts into One in Hybrid Fenders

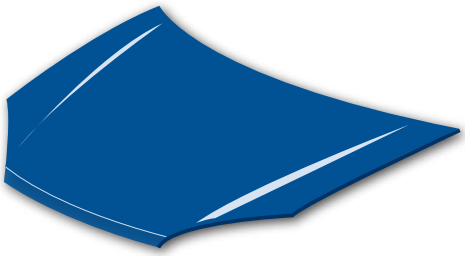
Besides opening possibilities for unique designs, substituting composites also consolidates four metal parts into one, based on ACA findings.

Composites are also dent and ding resistant and allow for the integration of wheel lip moldings.

## More Design Freedom for Composite Deck Lids

ACA's benchmarking indicates mass savings of 25% - 35% by consolidating four metal parts into a two-piece composite deck lid assembly. This helps increase fuel economy and lower tooling investment by 50% - 60%.

Using SMC on deck lids also allows the transmission of RF waves so that antennas for communication, navigation and audio systems can be seamlessly integrated.



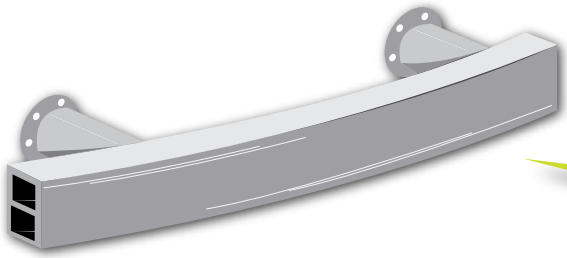
*30% - 40% mass savings and 60% - 70% reduction in tooling costs add up to an increase in overall operating efficiencies.*

## As Fuel Prices Rise, So Does the Demand for Hybrid Cars, Trucks and SUVs

*The Chevrolet Tahoe Hybrid, the only fullsize hybrid SUV, is just entering the market.*

*Toyota's Prius Hybrid set the pace, now followed by Camry and Lexus.*

## Carbon Fiber Improves Safety in Bumper Systems



- *Mass savings 30% - 40%*

Composite front and rear bumper reinforcements can offer mass savings in the 30% to 40% range.

If carbon fiber composites are used in crush cans, vehicle crash-worthiness will be improved.

# The Automotive Composites Alliance: Your Partner in Developing Hybrid Solutions...

*…And Here's Why: Nine Reasons for Choosing Composites*

Composites offer so many advantages, each application may have its own set. Compared to traditional materials, they offer:

- **Substantial weight reduction**: Fiber reinforced polymer (FRP) composites are typically up to 40% lighter than steel parts of equal strength.
- **Lower manufacturing complexity**: Finished assemblies with fewer parts cut manufactured costs and often accelerate design completion and model introduction.
- **Reduced tooling cost**: Tooling for composite parts can be as much as 80% less than for comparable metal parts.
- **Unparalleled damage resistance**: Composites' dent and ding resistance is far superior to that of aluminum, steel and thermoplastic panels.
- **Unrivaled corrosion resistance**: FRP composites are superior in corrosion resistance for any application.
- **Better internal damping**: Leads directly to reduced noise, vibration and harshness (NVH).
- **Improved design flexibility**: Molding offers shape complexity, geometry details and a depth-of-draw range unavailable with metal stampings.
- **Cost-effective solutions**: Lower composites investment cost satisfies automakers' trends toward reduced builds per model.
- **Improved processing**: Toughened SMC resin provides improved "first-time-through" processing, comparable to steel.

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