The Facts: Steel vs. Aluminum

Automakers are diligently working to satisfy regulatory requirements aimed at 2017 and beyond, where the concern for greenhouse gas emissions has caused fleet-wide Corporate Average Fuel Economy targets to double from 2012 to 2025. It is clear that vehicle lightweighting will play a critical role in meeting these requirements. Life cycle assessment shows that making advanced high-strength steel (AHSS) generates at least 1/5 fewer emissions than manufacturing other automotive body materials; therefore, steel-intensive automobiles will continue to be the overall lowest-emitting vehicles on the road, without compromising safety or affordability.

AHSS vs. Aluminum: Usage

- AHSS, which enables lightweight steel parts and assemblies to replace conventional steel systems, is the fastest growing material in automotive applications according to a report by Ducker Worldwide in 2010.

- Recent designs show lightweight AHSS chassis parts can replace those made of aluminum due to their affordable weight savings.

- Researchers at Mega Associates found that steel has remained between 58 and 62 percent of total vehicle weight over the last six years, despite intense materials competition. Aluminum represents about 8.6 percent, mostly in engine and powertrain castings.

AHSS vs. Aluminum: Mass Reduction

- The 2011 FutureSteelVehicle (FSV) project introduced more than 20 new grades of AHSS, many with strengths more than 1,000 MPa. The FSV Engineering Report proves how this portfolio of new steels can provide mass reduction well beyond what was previously believed possible with steel.

- New steel design methods and manufacturing processes, as demonstrated by the FSV project, have increased the mass savings achievable with steel to be essentially equivalent to production aluminum vehicles.
AHSS vs. Aluminum: Cost

- A Massachusetts Institute of Technology study and related cost models demonstrate aluminum to be significantly more costly than steel. For example:
  - Production of aluminum is two to three times more expensive than steel;
  - Manufacturing and assembly with aluminum is 20 to 30 percent more expensive than steel; and
  - According to FSV and Ducker Worldwide, mass reduction with steel can be achieved at nearly zero cost, while engineering studies show low-density materials like aluminum cost $2.75 or more per pound saved.

AHSS vs. Aluminum: Safety:

- Steel remains the dominant material for automotive front and rear crumple areas and passenger compartments, both critical zones for managing crash impact in vehicles.
- Consumers value the safety benefits of steel. When asked which auto components protect them most, the top three choices were seat belts, steel frames (the steel safety cage) and steel side-impact beams (placed inside car doors to better protect passengers in side-impact collisions).
- The FutureSteelVehicle program uses the “3G” principle—gauge, grade and geometry. Steel’s higher strength enables the use of thinner parts, or gauges, for the same performance. The use of multiple grades allows designers to put the strength, or any desired property, exactly needed and the formability of AHSS enable the use of parts with unique shapes to provide low-weight designs.
- FSV enables a five-star safety rating.

AHSS vs. Aluminum: Sustainability

- Life cycle assessment (LCA) is an established method of measuring the carbon footprint of products, accounting for total greenhouse gas emissions associated with vehicles. High-strength steels provide the only materials solution for mass reduction that also reduces greenhouse gas emissions in all phases of a vehicle’s life: manufacturing; usage phase; and end-of-life.
- LCA shows that steel, which currently makes up about 60 percent of the average North American vehicle, generates fewer manufacturing emissions than aluminum. Vehicles using high-strength steels provide significant reduction in driving emissions, as well as total life cycle emissions.
- Steel is recycled more than all other materials on the planet, combined with a remarkably high overall recycling rate. Recycling of automotive steel can reach over 100 percent, with new models being lighter and more fuel efficient than past models.
- Steel is magnetic, making it easily and affordably recycled. Because of steel’s physical properties, one product can be recycled into another without loss of quality, contributing to the material’s high recycling rate and affordability.
• Unlike aluminum, there is an abundant amount of recycled steel (approximately more than 80 million tons per year) available to manufacture new steel products.

• Due to its physical properties, aluminum is not recycled across products and very little aluminum automotive sheet is produced from recycled vehicles. This means that any increased use of aluminum sheet for automobiles must come from greenhouse gas intensive primary aluminum, which is approximately five times the greenhouse gas emissions of steel.

• The use of AHSS can reduce a vehicle’s structural weight by as much as 39 percent and can cut total life cycle CO$_2$ emissions by up to 15 percent more than any other automotive material, according to the FSV study.

• Steel supports the long-term growth of the North American job market, as the mining of coal, ore and limestone, as well as the primary material conversions, all occurs in the United States.