Automotive Steel Performance Advantages (ASPA)

Introduction

As environmental and climate change concerns escalate, pressure is being applied in every industry to reduce the GHG emissions produced by our modern lifestyles. Consequently, the automotive industry is receiving increasing pressure to reduce its environmental impact while maintaining safety and affordability.

In the process, **an erroneous perception has emerged that automotive light weighting and reduced GHG emissions are primarily associated with the application of low-density materials**, like aluminium, magnesium and plastics.

Based on published research such as the studies shown in the Reference Section of this document, steel, and in particular AHSS, is indeed the light weight material that best addresses society's need for **reduced GHG emissions without compromising safety and affordability**.

AHSS, currently the fastest growing material in automotive applications, is relatively new to vehicle design and is significantly different from the conventional steel it replaces. Its light weight capability results from its unique combination of strength and ductility. These attributes stem from complex composite structures of several different steel phases, each with unique material properties.

AHSS provides for light weight automotive solutions that are low cost and environmentally friendly, providing peace of mind and unmatched safety for automotive manufacturers and consumers. As automakers address the climate change impact of their products, steel remains the right choice for vehicle applications. The following are highlights of research that summarize automotive steel performance advantages.

package space is rigidly constrained by the need to maximize the space for powertrain and passengers. These combined conditions result in significant barriers when trying to reduce mass with lower density materials like aluminium.

Data cited in the study indicates that **actual aluminium body structures demonstrate mass savings between 16 and 40% relative to the conventional steel designs** they replaced.

However, the replaced conventional steel body structures were outdated, non-optimized designs constructed using traditional manufacturing techniques and conventional automotive steels.

In comparison, optimized **AHSS designs have demonstrated 21 to 25% mass savings relative to the conventional steel designs** they replace.

This achievement is reflected in the ULSAB family of research, as well as in automakers' own body structure designs in recent years. These projects and vehicles feature designs that make extensive use of AHSS and holistic design optimization and improve performance and crash safety along the way. Automakers have embraced these steel-intensive solutions and have established clear material strategies for their future that reflect the benefits of using these advanced steels.

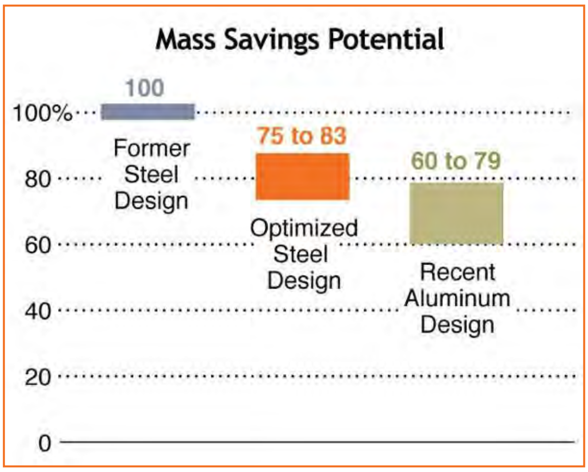

Figure 2: Mass savings potential

Overall, when looking at the evidence and the current state of the art in technology, the fka study concludes that aluminium designs provide 5 to 20% mass savings compared to an advanced steel design (Figure 2). In fact, the **average mass reduction advantage of aluminium is only 11%**, far less than the 40-50% reduction often communicated.

When engine and powertrain system resizing is not achieved, this study concludes that weight/fuel consumption elasticity values of only 2 - 4% are applicable.

The fka study also considers advanced powertrains, such as hybrids and fuel cell vehicles. The study concludes that these advanced future drivetrains, which take advantage of regenerative braking, do not see the same large variation in weight/fuel consumption elasticity with powertrain resizing as conventional internal combustion engines do. Historically, the often-stated weight elasticity figure of 8% has not been achieved. Such a high reduction in fuel consumption will be almost totally out of reach as hybrid and fuel cell power trains become more widely used.

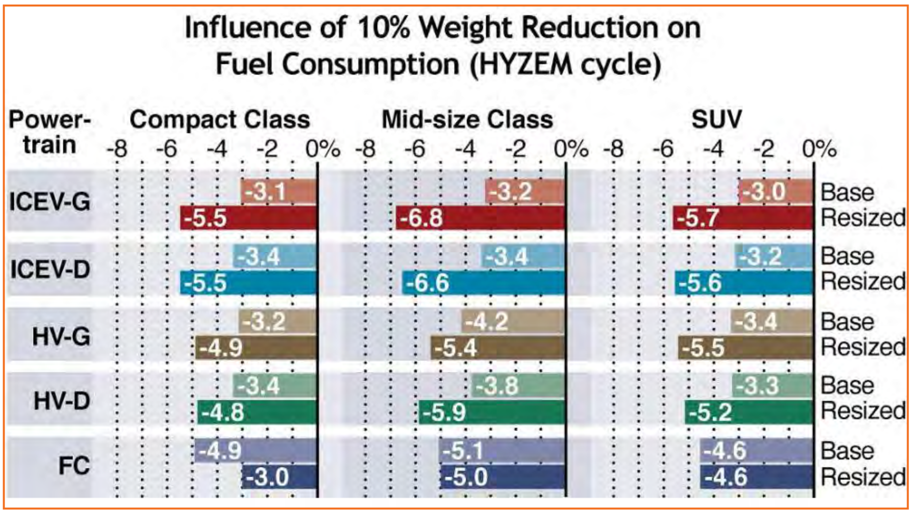

Figure 3a: Influence of 10% Weight Reduction on Fuel Consumption (HYZEM)

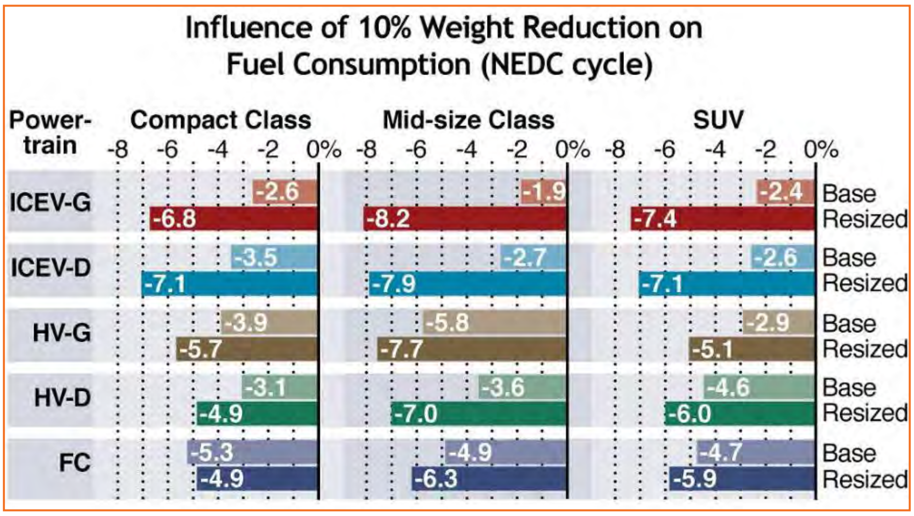

Figure 3b: Influence of 10% Weight Reduction on Fuel Consumption (NEDC)