

## **Environmental and life Cycle Advantages of Aluminum-Intensive Vehicles**

**Dr. D.M.Moore and Dr. M. J. Wheeler**  
**Alcan Global Automotive Solutions**  
**Farmington Hills, Michigan**

### **Abstract**

Lightweighting vehicles is the surest and most universally applicable way for reducing fuel consumption and the related emissions, no matter whether the fuel used is gasoline, light oil diesel fuel or electrical energy from thermal power stations. And aluminum is, by far, the most readily available and cost effective material with a proven track record for achieving significant weight reduction in vehicles. It can achieve this without impact on vehicle size and safety while, at the same time, providing a very positive impact on the overall reduction in the generation of greenhouse gases. The reasoning and facts supporting these statements will be developed in this presentation together with a look at the future of aluminum utilization in the auto industry. This promises the closed loop recycling of automotive aluminum, bringing with it further reductions in the net greenhouse emissions, the potential of cost reduction and the increased conservation of natural resources.

Several production and numerous prototype aluminum vehicles have been developed including the GM EV<sub>1</sub> and Precept models, the Ford P2000 and Prodigy prototypes and the Audi A8 and A2 production models. Also, aluminum is now used extensively in regular production vehicles in a variety of product forms, a recent example being the all-aluminum liftgate for the GM Suburban and Tahoe Vehicles. The experience from all these applications is that, with good design and by fully exploiting the strength and low density of aluminum, 1 kilogram of aluminum can replace 2 kilograms of steel or cast iron. It is important to note that the typical make-up of the average 113 kg of aluminum in today's cars and light trucks contains about 60% of recycled metal. Also it is estimated that some 95% of this aluminum is recovered, much of it through the shredding of end-of-life vehicles and its subsequent reclamation from the non-ferrous fraction of the shredder product. Typically 10 times as much steel as aluminum is recovered from auto shredders, but the value of the aluminum equals that of the steel and thus, even today, aluminum plays a very important role in the overall economics of end-of-life vehicle recycling.

Numerous studies by the auto industry have all shown that constructing vehicles using a low density material such as aluminum can substantially reduce their fuel consumption compared with construction using higher density, conventional materials. Estimates made by the car companies for gasoline powered vehicles, when the full benefits of lightweighting are taken, that is when secondary weight saving is exploited, range from 5 to 10% fuel economy saving for each 10% of weight saving. There will thus be a corresponding reduction in exhaust gas emissions, and especially CO<sub>2</sub> throughout the service life of such vehicles.

Lightweighting vehicles by using aluminum will therefore significantly reduce the fuel consumption and exhaust emissions over the lifetime of vehicles. The use that is made of recycled aluminum in automotive production significantly reduces the net energy required to supply this aluminum and increases the reductions in CO<sub>2</sub> that result.

In order to predict the impact of using aluminum to replace or instead of iron and steel in automobiles, a simple and straightforward approach of calculating the benefits from weight saving has been adopted. This can then be applied to any relevant vehicle or fleet of vehicles by inserting the appropriate data for the weight and form of aluminum used, and the weight saving achieved.