

1. INTRODUCTION

The energy consumption of on-road heavy trucks has been increasing due to the growth in demand for freight delivery as the U.S. economy continues to expand. The recent rapid rise in fuel prices has raised fuel costs to be the number one concern of the trucking industry. Owners and operators of trucks and truck fleets have been operating on “razor thin” margins and increasing the fuel economy of their vehicles is one way of reducing their fuel costs to remain viable as a business. One way of achieving heavy vehicle fuel economy improvements without sacrificing revenue earnings limited by maximum allowable vehicle weight or volume is through the use of high strength weight reduction materials for either or both the tractor and trailer. Vehicle weight reduction results in reduced parasitic energy losses and improved overall vehicle fuel efficiency by enabling more ton-miles per gallon of fuel consumed. In addition, it is recognized that improved materials may enable the implementation of other technologies that can further improve the fuel efficiency of heavy vehicles.

The High-Strength Weight Reduction (HSWR) Materials Technology activity of the U.S. Department of Energy’s (DOE’s) Office of FreedomCAR and Vehicle Technologies (OFCVT) Program seeks to reduce the weight of heavy vehicles without reducing vehicle functionality, durability, reliability, or safety and to do so cost-effectively. Work has been focused on developing advanced materials and materials processing technologies that can be applied to a wide array of heavy vehicle body, chassis, and suspension components to achieve weight reduction. Research is focused on overcoming barriers to the widespread introduction of lightweight materials in the heavy vehicle industry. Major barriers include: cost; design and simulation technologies; manufacturability; prototyping and tooling; joining and assembly; and maintenance, repair, durability, and recycling. Priority materials include advanced high-strength steels, aluminum, magnesium, titanium, and composites such as metal matrix materials and glass- and carbon-fiber-reinforced thermosets and thermoplastics. The research required to develop these technologies is too high-risk to be pursued independently by the heavy vehicle industry because of substantial return-on-investment uncertainties. In addition, the relatively low volume of truck components makes it difficult for any individual truck manufacturer to develop on its own a new production/fabrication process utilizing new kinds of materials such as composites.

Research and development (R&D) activities were conducted through a variety of contractual Mechanisms. These include cooperative research and development agreements (CRADAs), university grants, R&D subcontracts, and directed research. Research partners include heavy vehicle manufacturers (including member companies of the government/industry 21st Century Truck Partnership), first-tier component manufacturers and materials suppliers, national laboratories, and other non-profit technology organizations. Laboratories include Argonne National Laboratory (ANL), Idaho National Engineering and Environmental Laboratory (INEEL), Los Alamos National Laboratory (LANL), Oak Ridge National Laboratory (ORNL), and Pacific Northwest National Laboratory (PNNL).

Among the several goals established for this development area, one is to enable at least a 22 percent reduction in the weight of an unloaded tractor-trailer combination and about a 10-33 percent reduction in the weight of other classes of heavy vehicles, depending on performance requirements and duty cycles. With the completion and issuance of this final High Strength Weight Reduction Materials report, most of these goals have been accomplished. Technology research and development results have been made available to industry for further development and commercialization. Some of these results are discussed in this final annual report.

