

More Energy-Efficient Transportation

Lightweight Magnetic and Structural Nanomaterials

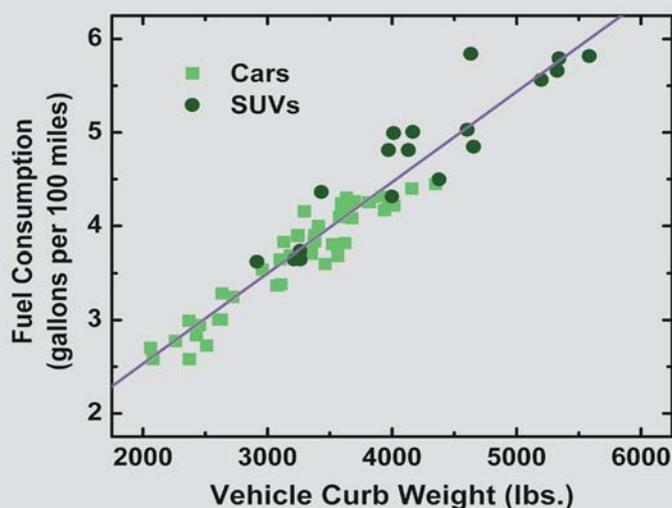
Interested Agencies: DOD, DOE, DOT, EPA, NASA, NIH, NIST, NSF

A study by the National Academies, titled *Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards*, found that reducing the weight of a vehicle by twenty percent results in a fifteen percent reduction in fuel consumption. A few specific examples illustrate the importance and magnitude of this relationship between vehicle weight and transportation fuel efficiency. AirTran recently installed carbon-fiber-based seats in its 737-700 Series aircraft, which shaved 19.4 pounds from each row of seating and is estimated to result in fuel savings of \$2,000 per year per aircraft. Boeing estimates that weight savings due to use of carbon fiber composite materials in its new 787 aircraft will increase fuel efficiency by as much as twenty percent. Such reduction in fuel consumption for transportation has the additional benefit of reduced outputs of greenhouse gases.

Nanotechnology offer possibilities for production of new strong and lightweight materials that also may exhibit superior magnetic and mechanical properties. These materials could result in weight reduction in transportation vehicles. For example, calculations predict that nanocomposite magnets could have

magnetic strengths twice as high as those of the best commercial magnets in use today. These magnetic materials could significantly reduce electric motor weight and size in hybrid automobiles, railway systems, and subways. Application of nanostructured composite materials may also allow designers to reduce the weight of structural components without compromising stiffness or other properties that are essential for passenger safety.

To realize the potential of nanotechnology-based materials, key scientific and technological barriers must be overcome. Improved synthesis and processing techniques must be developed to enable bulk fabrication of nanomaterials, to ensure high quality and purity of the nanomaterials, and to control their structure at the nanoscale.



Relationship of fuel consumption rate to vehicle weight for a representative set of vehicles used in the United States. Data from: *Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards*, National Academy Press (Washington, DC: 2002)