



## **Key Deficiencies in the 1997 and 2003 Weight/Fatality NHTSA Studies**

### ***Initial Review***

October 15, 2003

The National Highway Traffic Safety Administration (NHTSA) today released a 330-page study updating its 1997 study on the effects of hypothetical changes in vehicle weight upon fatalities. Since the original study by NHTSA researcher Charles Kahane was given political weight far outstripping its utility or value, we have every reason to think that its successor will receive a similar reception. Because of the political significance of the study despite its serious and continuing flaws, we have compiled this guide to public understanding. This is the initial review. It is based on a quick perusal of the new study and a thorough understanding of the 1997 study.

The key flaws in both studies are the same:

- 1) There is no connection in the assumptions in either study to the historical record on manufacturer decisions regarding how to improve fuel economy, which was achieved 85 percent through the use of technology.
- 2) Kahane's methodologies confuse results based on size and design with those based on weight.
- 3) The conclusions bear no relationship to the effect of CAFE on vehicle safety and fail to reflect the real-world data, which is available for analysis.
- 4) The studies look at the wrong issue: size and design, not weight, actually matter most for safety. Moreover, new high-strength materials could change the relationship of size and weight in the future, dramatically altering both safety and fuel economy outcomes.
- 5) The studies steer us in the wrong direction: Weight is actually harmful to both safety and fuel economy, and the interaction of the two produces a lose-lose policy. Lax fuel economy standards have allowed automakers to increase vehicle weight and acceleration over the past decade, with devastating effects for both safety and the environment.

Instead of updating the Kahane study, NHTSA should have:

- 1) Used the available historical record on vehicle weight changes under the Corporate Average Fuel Economy (CAFE) program;
- 2) Distinguished, as did Dynamic Research Inc. (DRI), the divergent impacts of weight and size within the research model;
- 3) Conducted a vehicle make/model specific analysis to identify factors that improve safety consistent with improvements in vehicle fuel economy and use "best in class" analysis to highlight its findings;

- 4) Developed expertise in new vehicle technologies and lightweight high-strength metals capable of achieving major improvements in fuel economy;
- 5) Examined opportunities for “win-win” design when analyzing vehicle quality and safety to estimate the likely future impact of CAFE standards; and
- 6) Set more meaningful fuel economy standards for both passenger cars and light trucks.

### **The 1997 Kahane Study Was “Exhibit A” for the Auto Industry in Battling Increases in Fuel Economy**

Kahane’s 1997 study was heavily promoted by the auto industry and was, arguably, badly mis-used in the National Academy of Sciences’ (NAS) 2002 report on passenger vehicle fuel economy. The NAS Report was, in turn, often quoted by the auto industry and members of Congress as a reason to oppose improvements in fuel economy standards, even though the NAS specifically acknowledged that the Kahane study was not a good tool for predicting future outcomes.

The outcome of any revision or update to the study is thus is a matter of substantial political importance, on which may turn the fate of the nation’s continuing addiction to oil. It is indeed no overstatement to say that the study is likely to significantly impact our national security and foreign policy, and well as efforts to alleviate global warming, pollution, cancer and asthma, and to improve safety.

Below is a list of important principles which may assist the interested public in understanding what the study does, and does not, mean.

#### **1) Neither Kahane study is grounded in the historical record on the impact of fuel economy standards.**

In fact, both the new study and Kahane’s initial study ignore the data available from the Environmental Protection Agency on the real world impact of corporate average fuel economy (CAFE) standards on car design or weight, substituting a hypothetical formula which reduces vehicle weight by an arbitrary 100 lbs.

*Neither study connects the hypothesis to any real-world data about the impacts of CAFE, i.e., there is no showing that CAFE standards had in fact caused an across-the-board reduction of 100 lbs. or any other amount.* Kahane did not even try to make a connection – the original study used 1993 data and the updated study uses data from 1991 through 1999, years in which there was *no increase in federal fuel economy standards*. In fact, the 1985 standard of 27.5 mpg for cars was in effect throughout the period, and did not change from 1990 to 1999.

Citing the Kahane study as proof that CAFE standards hurt safety, as the NAS report did, is profoundly misleading: No link between Kahane’s assumptions and the actual historical impacts of CAFE on vehicle weight was ever asserted or established by the studies. In fact, 85 percent of improvements in fuel economy came from technology, and weight reductions in cars

under CAFE occurred only in the largest vehicles, where it was most cost-effective and achieved the greatest fuel savings for manufacturers.

## **2) Kahane's Methodology Is Flawed.**

In his 1997 study, Kahane went through three steps to reach his conclusion. Using linear regression analysis to measure the relationship between curb weight (including a reduction in wheelbase and track width) and fatality rates, the study:

1. Held light truck weights constant and reduced cars by 100 lbs. (with accompanying reductions in wheelbase and track width);
2. Held car weight constant and reduced light trucks by 100 lbs. (with accompanying reductions in wheelbase and track width);
3. Added the results.

While slimming down cars by 100 lbs. showed a considerable increase in fatalities (302 overall, mainly from increased rollover and impacts between cars and light trucks), the second step went a small way in the other direction, showing a small savings of life from reducing light trucks by 100 lbs. (40, the majority of the lives were saved in impacts with passenger cars).

The new study replicates the same flaws, but in a slightly new way. Within vehicle categories, researchers compared fatality rates in vehicles of a certain weight with other vehicles in that category that weigh 100 lbs. less. This approach changes the equation somewhat, but still fails to distinguish among the confounding effects of size and weight. It also utterly washes out the effect of safety design. For example, if the Honda Civic, an extremely popular and safe car, is part of the sample in the initial category, but the comparison group is comprised of another, inferior make/model that weighs 100 lbs. less, safety outcomes would be dramatically downgraded. Yet the change in outcomes is far more the result of better safety design in the Civic than a 100-lbs. reduction in weight.

And research has consistently demonstrated that weight and size, while closely associated in the data, have a divergent effect on safety. The "Third International Congress on Automotive Safety" in July 1974 included a focus on two themes: Big Car/Small Car Interactions, and Future Vehicle Mix and Automotive Safety. A paper presented by Brian O'Neill, William Haddon, and Hans Joksch, entitled, "Relationship Between Car Size, Car Weight, and Crash Injuries in Car-to-Car Crashes," noted that:

For vehicles using the same roads these relationships suggest a crashworthiness design concept for intervehicular crashes that regards increases in vehicle size as primarily protective, and increases in vehicle weight as primarily hostile, indicating the desirability of relatively sizeable but not heavy vehicles.

In other words, increasing weight increases risk, while increasing size reduces risks by interposing space between the vehicle or struck object and a person inside. New high-strength

but lightweight metals therefore offer a chance to increase fuel economy without decreasing size or passenger comfort. Yet in designing his studies, Kahane put aside this considerable body of knowledge in favor of an approach that confuses any distinction between vehicle weight and size, instead treating weight as the important factor for safety *per se*. (See the Introduction to the Executive Summary, at vii (2003)).

Other research should have informed NHTSA that isolating weight as a factor would produce misleading results. A study by Dynamic Research, Inc., for Honda, replicating Kahane's 1997 methods, found that Kahane's initial results were caused by the changes in the trackwidth of vehicles, not the weight. Because trackwidth is a design decision by automakers that can be distinguished from weight, Kahane's conclusion is utterly avoidable with better design.

In agreement with the 1972 research cited above, DRI concluded that weight reductions improve safety, while wheelbase reductions harm safety. But because the Kahane studies' inquiry begins and ends with weight, the relevance of these distinctions is ignored. Sorting the data by weight category produces results, just ones that are not very illuminating. Because Kahane's starting assumption is that weight matters, the studies still conflate these factors. Yet, a substantial body of other research shows that size and design, not weight, matter most for safety.

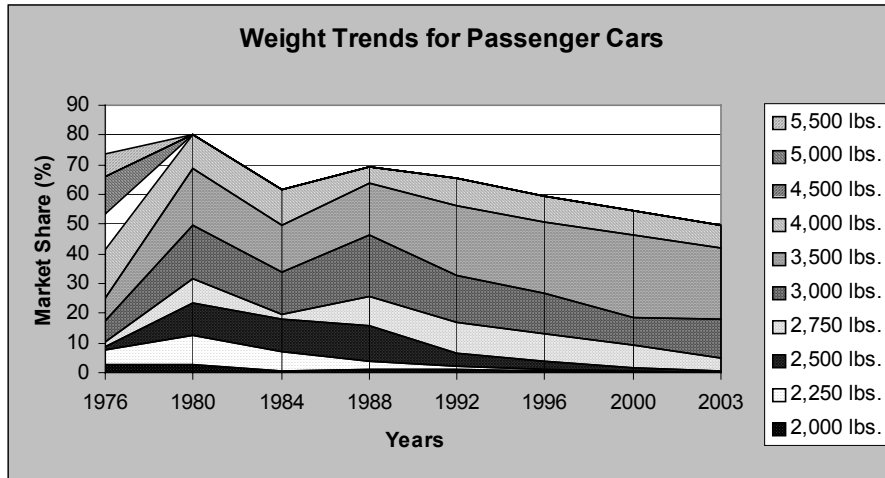
### **3) Real-world data on vehicle weight under CAFE do not support Kahane's assumptions or hypothesis. In fact, both vehicle safety and fuel economy improved over the relevant time period.**

EPA data show that the weight of the car vehicle fleet did not uniformly shift downward under CAFE; instead, only the largest cars changed in proportion to the total car fleet. Because the largest cars pose the largest threat in crashes among cars, this change was likely beneficial for safety. There was also no "explosion" of tiny cars, as opponents of CAFE increases predicted there would be.

Instead, there was consolidation in the weight of the vehicle fleet. As the following graph below shows, since 1976, the market share for new cars weighing 3,000-3,500 lbs. nearly doubled, rising from 15 percent to a 37 percent total market share in 2003. Meanwhile, at just over 10 percent in 2003, the market share of new cars weighing 2,000-2,750 lbs. is half what it was in 1976. The largest cars, weighing more than 4,000 lbs, have all but disappeared. This shows that automakers will use weight changes to improve fuel economy in the largest vehicles, where an expensive make/model redesign is most cost-effective. *In fact, 85 percent of fuel economy gains in the fleet were from technology, not weight reduction.*

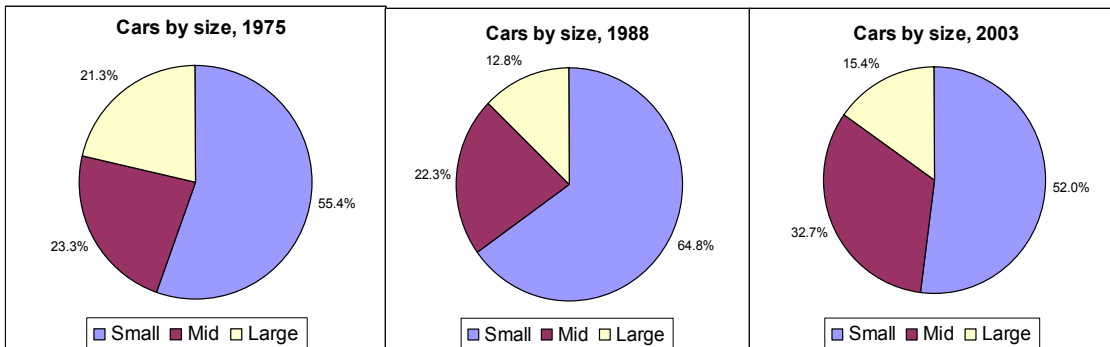
These changes occurred at the same time that lines at gas stations and an international oil crisis added substantially to consumer interest in smaller, more fuel efficient cars, showing that market preference, as well as CAFE, influenced changes in the vehicle fleet mix.

**The Market Share of the Smallest and Largest New Passenger Cars Dwindled Away as Passenger Cars Consolidated around the 3,000-3,500 lbs. Weight<sup>1</sup>**



Furthermore, as this shows, it is profoundly fraudulent to treat the original Kahane study as the NAS did: as an annual, cumulative accounting of the lives lost from CAFE. Instead, the historical picture tells us that as technology for fuel economy advanced, there was no steady loss of weight or size among cars. Indeed, the proportional distribution of cars by size category today looks very similar to the pre-CAFE picture, as the graphs below illustrate. Data is from the 2003 EPA Trends Report.

**MINIMAL INCREASE IN NUMBER OF SMALL CARS IN 1988, BUT SIZE DISTRIBUTION WITHIN CAR VEHICLE FLEET NEARLY IDENTICAL IN 1975 AND 2003**



The effect of CAFE on vehicle weight, was not, in fact, cumulative from year to year, but shifted along a technology horizon that controls the cost-effectiveness of technological versus weight-related options for improving fuel economy. Because there are literally dozens of on-the-shelf, yet unused, technologies that have been developed to improve fuel economy today, it is very likely that any changes in weight would only be cost-effective in the heaviest vehicles in the fleet, where they provide the most “bang for the buck.” And down-weighting among the heaviest vehicles improves safety for all other vehicles on the highway. Safety improvements could also be an essential part of any re-design to improve fuel economy, producing a win-win for people and the environment.

#### **4) Size and design, not weight, matter most for safety.**

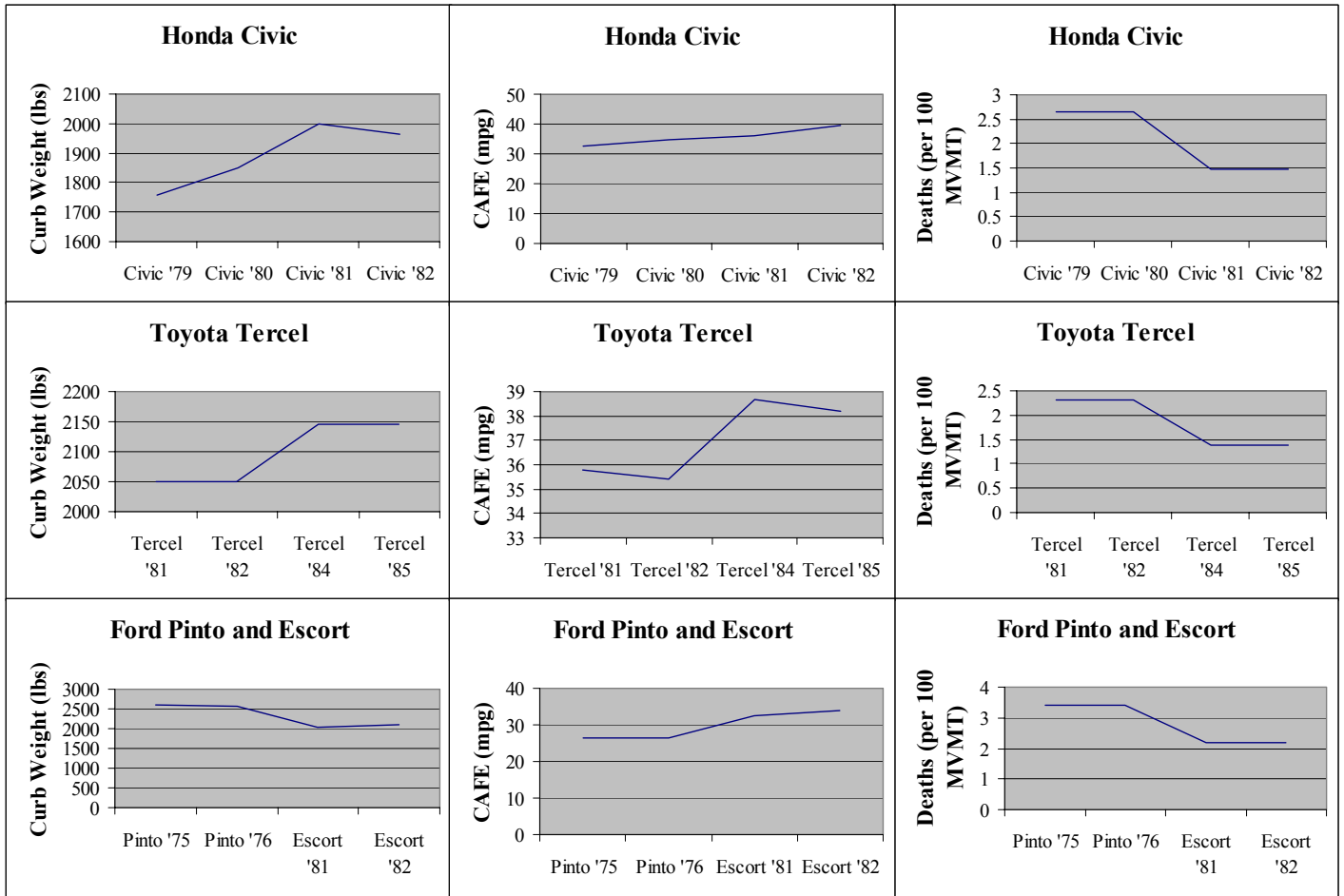
Auto industry defenders often argue that fuel economy standards’ impact on safety is a matter of “simple physics.”<sup>2</sup> The myth is that increasing CAFE standards would cause weight loss across vehicle sectors, compromising safety. The executive summary of the new 2003 Kahane report reflects this mindset. The studies look at the wrong issue: size and design, not weight, actually matter most for safety. Moreover, new high-strength materials could change the relationship of size and weight in the future, dramatically altering both safety and fuel economy outcomes.

Researchers looking into aggressivity and compatibility have discovered that the physics of safety are anything but simple. Driver death rates in some smaller passenger cars are far lower than driver death rates in some SUVs and other light trucks.<sup>3</sup> Make-model specific studies of vehicle fatality trends have shown that, historically, similarly weighted vehicles have had highly disparate safety effects for both their own occupants and other drivers on the road.<sup>4</sup>

Marc Ross, of the University of Michigan, and Tom Wenzel, of Lawrence Berkeley National Laboratory, recently completed a study for the Department of Energy of driver death rates grouped by both vehicle type and model. They found that while the safest mid-size cars were as safe as the safest SUVs, that “SUVs impose a greater risk on drivers of other vehicles than do all types of cars.” Pickup trucks, a vehicle category that is on average larger, heavier and stiffer than passenger cars, have a *combined* risk to their drivers and the occupants of other vehicles that “is much higher than that for other vehicle types.”

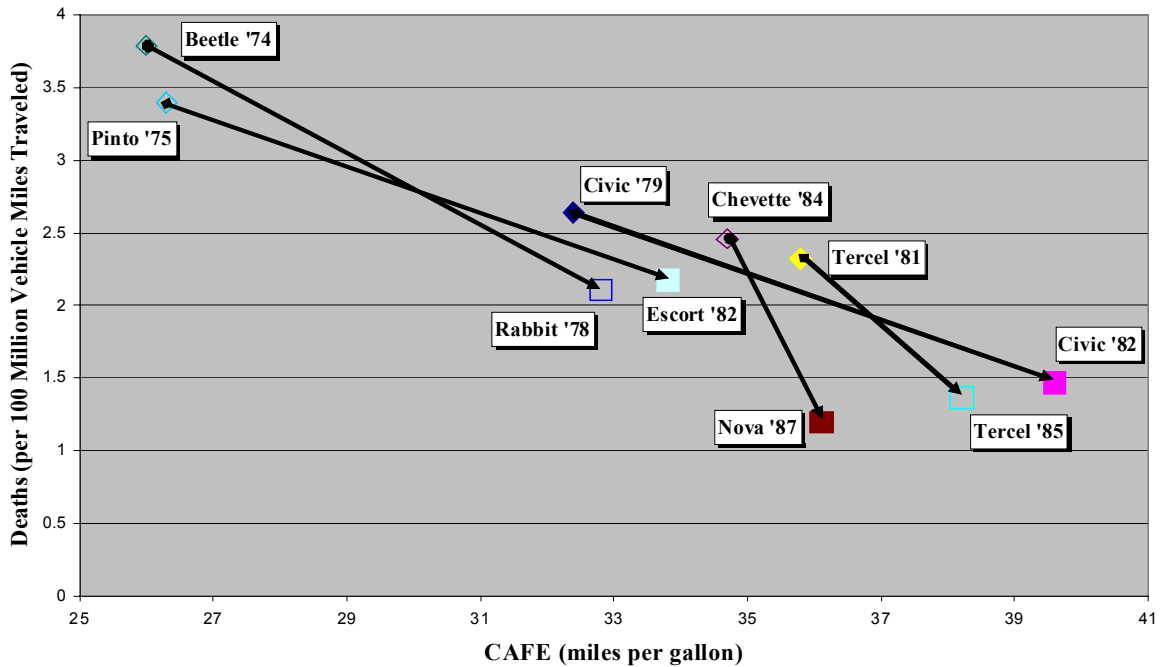
While Ross and Wenzel conclude that some vehicle types are overall more risky than others, they also point out that vehicle quality and safety design, which vary throughout each vehicle class, play a large role in overall risk. The range of risk within each vehicle type proves that a vehicle’s overall safety is not dictated by mere weight, and that manufacturers determine safety through sound or inadequate engineering choices. Ross and Wenzel also conclude that, in terms of CAFE-related weight decreases, the “argument that the low weight of cars with high fuel economy has resulted in many excess deaths is unfounded.”<sup>5</sup>

Other historical data prepared by Clarence Ditlow of the Center for Auto Safety, comparisons of matched pairs of the same model, shows simultaneous improvements in both fuel economy and safety, when compared to the pre-CAFE vehicle, for several model vehicles. Many of the vehicles actually increased in weight in comparison to pre-CAFE levels, as in the three popular models depicted below. Under CAFE, vehicles such as the Honda Civic went from failing government crash tests to the best ratings while gaining 800 lbs. and improving fuel economy.



In the graph below, all vehicles improved in CAFE over the relevant period at the same time that safety improved.

**Matched Pair Analysis: Efficiency Versus Safety**



## 6) Weight Kills.

Although the myth that a heavy vehicle offers better occupant protection is often bandied about, vehicle weight is actually a poor predictor of occupant safety. As three decades of NHTSA research on aggressivity show, weight can raise the level of violence in crashes between two large, heavy vehicles. Because heaviness is often correlated positively with stiffness and negatively with rollover propensity for light trucks, the overall effect is that large, heavy vehicles offer little or no safety advantage to occupants. We therefore strongly disagree with the assertion in the 2003 study at vii that “heavier vehicles tend[] to be more crashworthy and less crash-prone.”

As light trucks continue to flood the highways, their ethically dubious advantage over smaller vehicles in multiple-vehicle crashes is also dissipating. Yet heavier vehicles do inevitably pose a higher risk to other occupants and pedestrians. And both weight and the aggressivity of vehicle design play a major role.

Over a decade of detailed data on vehicle trends and weight from the EPA Trends report drives home two of our most significant points. The data show a considerable up-weighting in vehicles, particularly in the light truck fleet, which has increased the net violence in crashes with other vehicles and with fixed objects on the road. This up-weighting is possible because annual fuel and engine efficiency gains from regular technological improvements to vehicles (a gain of



approximately 1.9 mpg each year) have not been used, or required to be used, to meet federal fuel economy standards. This record shows that, even without fancier technological advances, automakers experience a steady increase in their fuel efficiency. Yet the absence of meaningful federal rules allows them to funnel such advances into bulking up weight, acceleration and horsepower, inflicting new harm on both safety and the environment.

The agency should examine the actual historical effects of the diverging vehicle fleet and the proliferation of light trucks. The real story is that the last decade's lax CAFE standards for light trucks has resulted in an ever-more dangerously divergent vehicle fleet in terms of both weight and size, allowing manufacturers to ramp up sales of their most rollover-prone, aggressive vehicles, thus gravely degrading the safety of the American highway.

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The importance of acting soon to raise fuel economy cannot be understated. A meaningful new fuel economy standard, extended to vehicles up to 10,000 lbs., would provide manufacturers with both the incentive and the opportunity to comprehensively re-design their vehicles to improve fuel economy and safety at the same time, and would finally put an end to this deeply misleading debate, a debate which has substituted red herring distractions for real solutions and has far too long delayed action for the real public good.

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<sup>1</sup> U.S. Environmental Protection Agency. (April 2003). *Light-Duty Automobile Technology and Fuel Economy Trends: 1975 Through 2003*. (EPA 420 R03 006). Washington: General Printing Office. Appendix H.

<sup>2</sup> See Comments from the Alliance of Automobile Manufacturers, Docket Number, NHTSA-2002-11419.

<sup>3</sup> See Insurance Institute for Highway Safety *Status Report*, Vol. 35, No. 7, Oct 19, 2000.

<sup>4</sup> See Marc Ross and Tom Wenzel, "An Analysis of Traffic Deaths by Vehicle Type and Model," U.S. Department of Energy LBNL-49675, Washington, DC, Mar. 2002.

<sup>5</sup> See Marc Ross and Tom Wenzel, "An Analysis of Traffic Deaths by Vehicle Type and Model," U.S. Department of Energy LBNL-49675, Washington, DC Mar. 2002, at 5-6.