CHAPTER 5

Carbon Burdens from New Car Sales in the United States

John DeCicco, Freda Fung, and Feng An

In mature industrialized economies, cars typically account for the largest portion of transport-related greenhouse gas (GHG) emissions, and nowhere is this more true than it is in the United States. Cars—referring to all light-duty vehicles (LDVs), including passenger cars, light-duty trucks, and sport utility vehicles (SUVs)—emit just over 60 percent of the carbon dioxide (CO_2) from the U.S. transportation sector, which itself accounts for one-third of U.S. energy-related CO_2 emissions overall (Davis and Diegel, 2004). Because the United States is the world's largest emitter of GHGs, its cars account for a significant portion of the world's heat-trapping emissions—about 5 percent of the global energy-related CO_2 emissions. For perspective, U.S. cars alone emit more than the total CO_2 emissions of all but four countries—China, Russia, Japan, and India—exceeding the nationwide emissions of many large countries such as Germany and Brazil.

In tabulations by agencies such as the U.S. Environmental Protection Agency (EPA) and the International Energy Agency (IEA), the transportation portion of a GHG inventory includes only emissions from a vehicle during its operation, mainly its tailpipe CO_2 emissions from fuel combustion, plus trace gas emissions (EPA, 2005). A full accounting would incorporate the entire vehicle lifecycle, called the full fuel cycle, including emissions from supplying the fuel and manufacturing the cars and their components. Manufacturing, for example, accounts for about 11 percent of total automobile lifecycle emissions. The remaining 89 percent is proportional to the amount of fuel consumed, although roughly 30 percent of these emissions occur upstream in the fuel supply chain.

Automotive carbon burdens are the results of decisions made by public officials who finance and shape much of the transportation system, oil companies that supply motor fuel, automakers that build cars, and consumers who drive them. Because car design is such a key determinant of CO_2 emissions rates, automakers' product strategies have a profound impact on the sector's inventory. The carbon burden concept isolates this impact by focusing on the new vehicle market and controlling for other factors, such as amount of driving or carbon content of fuel, that influence automobile CO_2 emissions largely through decisions made by parties other than automakers.

The carbon burden concept underscores how the ultimate effectiveness of actions taken to cut CO_2 emissions must be evaluated according to tons of carbon reduced, rather than the type of technology or fuel used (DeCicco et al., 2005). Similarly, the effectiveness of measures to reduce petroleum dependence is ultimately measured in terms of barrels of oil consumption avoided. Focusing on these metrics of barrels of oil and tons of carbon provides a robust framework for assessing strategies to reduce auto sector oil demand and GHG emissions.

This chapter reviews the historical U.S. light vehicle carbon emission trends from all LDVs, new and used, over the period from 1970 through 2003, and highlights new vehicle CO_2 emission rates and related factors for each major automaker for the more recent period from 1990 through 2003. Primary data sources for our analysis include the National Highway Traffic Safety Administration (2005) and Hellman et al. (2004). It examines only tailpipe CO_2 emissions so that the findings can be directly compared to the findings of studies by other agencies monitoring GHGs. Thus, carbon burden is expressed as the expected annual direct CO_2 emissions averaged over a vehicle lifetime. The calculations assume that all vehicles are driven 12,000 miles per year, emit 19.4 pounds of CO_2 per gallon of fuel burned, and have an average 15 percent shortfall in fuel economy relative to the laboratory test values used for Corporate Average Fuel Economy (CAFE) compliance.

Trends in U.S. Automotive CO_2 Emissions

The total CO_2 emissions, as well as the average emission rates of all vehicles in each automaker's fleet, have continued to rise despite notable changes in factors thought to influence emissions. In particular, the past five years saw much higher gasoline prices than the period from 1990 to 1998 as well as notable developments in technology, such as the introduction of hybrid electric vehicles (HEVs). Examining aggregate emissions trends shows that annual sales of even a million HEVs—which some analysts foresee as early as 2010—would not suffice to offset even half the increase in CO_2 emissions and oil consumption observed in the auto market between 1990 and 2003.

The new fleet average CO_2 emission rate per vehicle is shown as the thicker line in Figure 5-1. It had been rising prior to the 1973 oil embargo,

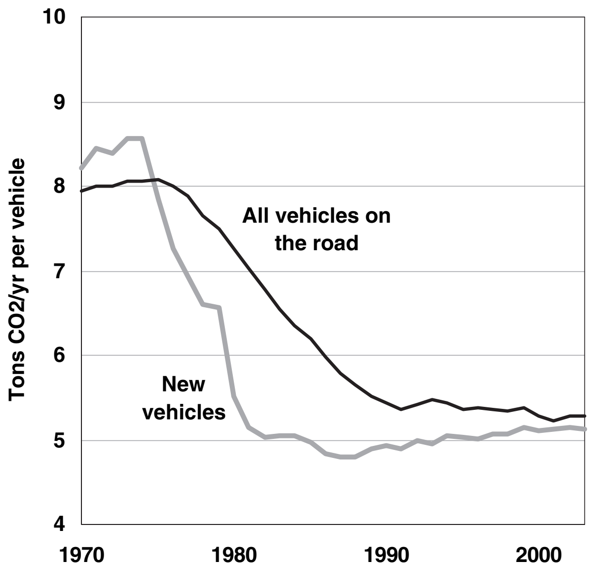

FIGURE 5-1. Average CO_2 emissions rates of U.S. light-duty vehicles, new fleet and on-road stock. *Source:* DeCicco et al. (2005), as derived from U.S. government statistics. *Notes:* CO_2 emissions measured by metric tons. One metric ton equals 1.102 short tons.

reaching a peak of 8.6 metric tons of CO_2 per year (TCO_2/yr) in 1973 and 1974. It then plummeted as fuel economy rose in response to gas lines, high fuel prices, general fears of fuel shortages, and the imposition of CAFE standards. The subsequent fuel economy decline due to the shift from cars to trucks pushed the new fleet average CO_2 emissions rate slowly upward from its historical low of 4.8 TCO_2/yr in 1987 and 1988. The thinner line in Figure 5-1 shows the average emissions rate of the total LDV stock, which lags that of new vehicles due to stock turnover. The stock average CO_2 emissions rate continued to decline into the 1990s, but subsequently has stagnated at about 5.3 TCO_2/yr.

Figure 5-2 shows the growth of U.S. automotive CO_2 emissions along with a key factor behind rising emissions—namely, growth in light-duty vehicle miles traveled (VMT). As shown by the thicker line, total LDV emissions reached 317 million metric tons of carbon per year (MMTc) in 2003. This CO_2 emissions level is equivalent to 8.6 million barrels of gasoline consumption per day, or 132 billion gallons per year. The 2003 level represents a net growth of 64 percent since 1970 and a 25 percent increase since 1990, a common base year for climate policy. Nevertheless, as Figure 5-2 shows, this growth in carbon emissions is much less than the 160 percent jump in VMT from 1970 to 2003. These trends illustrate how a decrease in

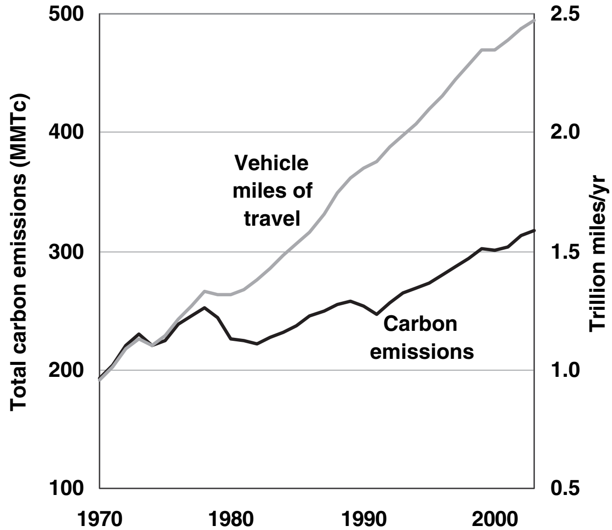

FIGURE 5-2. Vehicle miles of travel and total CO_2 emissions of light-duty vehicles in the United States. *Source:* DeCicco et al. (2005), as derived from U.S. government statistics.

CO_2 emissions rates, itself driven by the increase in fuel economy following the 1970s oil shocks, can at least partly offset the effects of increased driving.

Carbon Burdens of Major Automakers

The Big Six, including the six largest automakers in the U.S. market—General Motors (GM), Ford, DaimlerChrysler (DCX), Toyota, Honda, and Nissan—had an 87 percent market share and accounted for 88 percent of the new fleet carbon burden in 2003. The next six firms, measured by total U.S. sales—Volkswagen, Hyundai, Mitsubishi, BMW, Kia, and Subaru—had a combined market share of 12 percent in 2003 and accounted for nearly all of the remaining new fleet carbon burden. The ranking of new fleet carbon burdens by firm follows market share, with GM accounting for the largest total carbon burden.

Focusing on the Big Six, Figure 5-3 breaks down each firm's carbon burden growth from 1990 to 2003 into two components: sales increase and fuel economy decrease. The average fuel economy for all Big Six automakers decreased from 1990 to 2003, largely due to each firm's rising proportion of trucks in its total sales, known as the truck fraction, resulting in increased fleet-average CO_2 emissions rates. All automakers significantly expanded their light truck offerings, with the overall light truck fraction

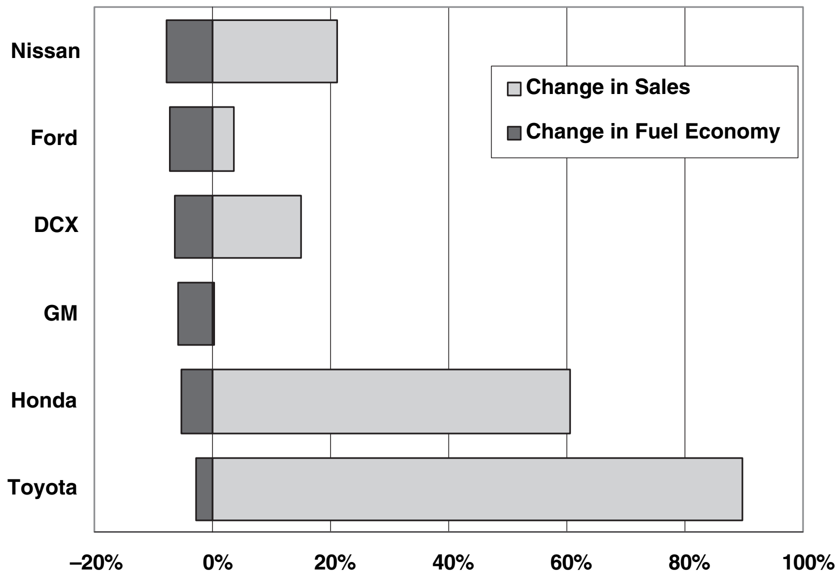

FIGURE 5-3. Breakdown of growth in Big Six carbon burdens, 1990–2003. *Source:* DeCicco et al. (2005) as derived from National Highway Traffic Safety Administration (2005).

growing 21 percentage points over this 14-year period. Nissan had the largest increase in its average CO_2 emissions rate due to the combined effect of rising truck fraction and declining truck fuel economy. Toyota's 95 percent increase in new vehicle carbon burdens was the greatest among the Big Six, but its fuel economy declined the least. Thus, Toyota's carbon burden increase was due predominately to sales success.

Two other trends have been serving to increase CO_2 emissions by U.S. cars and light trucks. One is the growing reliance on flexible-fuel vehicle (FFV) credits by the Big Three (GM, Ford, and DaimlerChrysler). Federal law gives automakers extra CAFE credits for selling FFVs, regardless of whether alternative fuel is actually used, enabling the companies to sell less fuel-efficient vehicles overall. The other adverse trend is an apparent increase in sales of heavier light trucks between 8,500 and 10,000 pounds gross vehicle weight. These vehicles are mainly three-quarter and one-ton pickup trucks, but include a growing number of the largest SUVs, such as the Hummer H2 and some models of the Chevy Suburban and Tahoe and their GMC brand variants. Because such vehicles have been exempt from CAFE regulation, data are not available to quantify the additional carbon burdens associated with their sales. In any case, the actual carbon burdens of the Big Three are even larger than reported here based on data for only the CAFE-regulated under-8,500 pound fleet.

The following sections provide summaries of the key findings on new fleet CO_2 emissions trends for each of the Big Six, plus shorter summaries for other automakers, during the period from 1990 through 2003.

General Motors

As the largest firm in the U.S. market, GM's model year 2003 fleet accounted for 29 percent of the total carbon burden from new LDV sales. This share is higher than GM's 28 percent market share because the average CO_2 emissions rate of its products is somewhat higher than the market average. Over each of the last four years before 2003, GM improved the fuel economy of its new car fleet, which was 5 percent higher in 2003 than it was in 1990.

Light truck sales at GM rose from 28 percent in 1990 to 56 percent in 2003 while showing no significant fuel economy improvement. Mainly as a result of this shift, GM's new fleet-average CO_2 emissions rate was 6.3 percent higher in 2003 than it was in 1990, reaching 5.4 TCO_2/yr per vehicle, about 5 percent higher than the market average in 2003. The company's market share dropped 6.8 percentage points during the period from 1990 through 2003, but GM still had the largest carbon burden overall, standing at 6.4 MMTc as of 2003.

Ford

Ford's market share dropped over 4 percentage points from 1990 through 2003, standing at 21 percent as of 2003. The company's 2003 total fleet carbon burden of 5.0 MMTc accounted for 23 percent of the market total. Light trucks rose from 35 percent of Ford's sales in 1990 to 59 percent as of 2003, while the average fuel economy of Ford's light trucks dropped by 2 percent compared to 1990.

Ford's SUV fuel economy dropped in 2003 after having risen for two years following the company's now-abandoned July 2000 pledge to improve fuel economy. Ford has also relied heavily on FFV credits. The combined effect of these factors pushed Ford's new fleet-average CO_2 emissions rate to a level 7.7 percent higher in 2003 than it was in 1990. That made Ford the company with the worst fleet average CO_2 emissions rate, 5.6 TCO_2/yr per vehicle, as of 2003, nearly 9 percent above the market average and 3.5 percent higher than GM.

DaimlerChrysler

DCX has become the automaker with the greatest dependence on light trucks. The truck fraction of its total LDV sales increased 24 percentage points since 1990 to reach 74 percent in 2003. While its average new car fuel economy revealed no obvious trend, DCX's light truck fuel economy rose 6 percent from 2001 through 2003, although it was still down a net 2 percent in 2003 from its 1990 level.

The combined share of Chrysler and Mercedes-Benz products in the U.S. market was 13.5 percent in 1990. Chrysler sales did very well in the mid-1990s, and the combined share was around 17 percent at the time of the merger with Mercedes-Benz to form DCX. Market share dropped after the merger, however, and was down to 12.4 percent as of 2003. Mainly as a result of the extensive shift to light trucks, but also due to the adverse effect of FFV credits, DCX's new fleet average CO_2 emissions rate ended up 6.8 percent higher in 2003 than the average level of the premerger firms in 1990. That level of 5.5 TCO_2/yr per vehicle was second highest in the market, just behind Ford. DCX's total fleet carbon burden of 3.0 MMTc in 2003 accounted for 14 percent of the market total.

Toyota

Toyota's market share gained 4 percentage points between 1990 and 2003, closing the period at just under 12 percent of the market. The company's new fleet average CO_2 emissions rate was up 2.9 percent over the period, the smallest increase among the Big Six. It stood at 4.6 TCO_2/yr in 2003.

Driven mainly by increased sales, Toyota's new fleet carbon burden saw net 95 percent growth from 1990, reaching 2.3 MMTc in 2003, 11 percent of the market total. The company's higher CO_2 emissions rate was caused by the 15-percentage-point increase in the truck fraction of Toyota's new vehicle sales. Toyota's average light truck fuel economy in 2003 was the same as it was in 1990, despite an extensive expansion of the company's lineup into SUVs and larger and more powerful trucks generally. Toyota's average new car fuel economy improved 4.9 percent but not nearly enough to compensate for the shift to trucks. Toyota's HEV sales were still too small as of 2003 to have a perceptible effect on its fleet-average CO_2 emissions rate and carbon burden.

Honda

Honda remained the fuel economy leader among the Big Six. As of 2003, only Volkswagen had a higher new fleet fuel economy overall among the top 12 automakers. Honda gained two percentage points of market share from 1990 to 2003, but its rapidly growing truck fraction resulted in a 5.7 percent rise in the company's average CO_2 emissions rate. That put its new fleet average CO_2 emissions rate at 4.3 TCO_2/yr in 2003. Honda's average truck fleet fuel economy dropped by 8 percent from 1997 through 2003, while its average new car fuel economy rose by 7 percent from 1990 through 2003.

Since entering the light truck market in 1997, Honda's truck share grew at an average 5.6 percentage points per year, reaching 39 percent in 2003. Driven by both market share gain and a rising CO_2 emissions rate due to higher truck fraction, Honda's 2003 carbon burden reached 1.7 MMTc, contributing 8 percent of the overall new LDV market carbon burden. Honda was first to introduce an HEV to the U.S. market, but as of 2003, like Toyota, its HEV sales were too small to significantly impact the company's fleet average CO_2 emissions rate.

Nissan

Nissan saw great fluctuations in its sales over the period from 1990 through 2003, although by 2003 its market share was about the same as in 1990 at 5 percent. During this time, the truck fraction of Nissan's sales grew from 25 to 36 percent, while its average new light truck fuel economy dropped 13 percent.

The net effect was that Nissan's new fleet average CO_2 emissions rate rose 8.4 percent between 1990 and 2003, the largest increase among the Big Six. That put its CO_2 emissions rate at 4.9 TCO_2/yr per vehicle as of 2003, still about 5 percent below the market average of 5.1 TCO_2/yr for the Big Six manufacturers. The 1.0 MMTc carbon burden of Nissan's 2003 new fleet was responsible for 4.8 percent of the total new LDV fleet carbon burden in 2003.

Other Firms

The collective sales of the next six largest automakers nearly tripled between 1990 and 2003, when their combined market share reached 12 percent and they accounted for 11 percent of the new LDV fleet carbon burden. Highlights of the carbon-burden related performance of the individual companies are as follows:

- Volkswagen more than doubled its market share from 1990 through 2003 while improving fuel economy and cutting its fleet-average CO_2 emissions rate by 3.3 percent. Corresponding to its high average fuel economy, Volkswagen's 2003 new fleet-average CO_2 emissions rate was the lowest among the 12 automakers examined here.
- Hyundai nearly tripled its market share from 1990 through 2003, but it had the worst increase, 16 percent, in new fleet-average CO_2 emissions rate among major automakers, shifting it from having the lowest new fleet CO_2 emissions rate in 1990 to the third lowest in 2003.
- Mitsubishi saw its market share generally decline from 1990 through 1998, but it had rebounded by 2003. Following the truck trend, the fuel economy of its sales mix declined to the point that the company's new fleet average CO_2 emissions rate increased 6 percent from 1990 through 2003.
- BMW improved its average fuel economy from 1990 through 2003 by more than any other firm, reducing its new fleet CO_2 emissions rate by

12.7 percent over the period in which it achieved a nearly fivefold increase in U.S. sales.

- Kia has steadily gained sales since entering the U.S. market in late 1993, but its new fleet CO_2 emissions rate rose 27 percent as it increased its truck sales and converged toward the market average.
- Subaru posted little net change in market share from 1990 through 2003 and its new fleet-average CO_2 emissions rate increased 3 percent over the period.

Notable Trends Influencing Carbon Burdens

The specific trends for each automaker discussed above reflect a number of broader trends in the U.S. auto market. A notable trend has been the ongoing erosion of the market share held by the Big Three. This occurred even as those same firms led the market into the light truck segments, largely through the popularity of SUVs. The resulting general shift to trucks became the main factor behind falling fuel economy and rising average CO_2 emissions rates. The trend toward use of FFVs has also contributed to the worsening CO_2 emissions rates of the Big Three.

While the latter years of the analysis period saw the introduction of HEVs, their sales remained small as of 2003. The fuel economy values of the HEVs introduced to date provide a basis for estimating the fuel saving characteristics of this technology as actually deployed. Such estimates provide a perspective on the likely CO_2 emissions impact of the nascent trend toward HEVs, which can be compared to the ongoing trend of shifting production from vehicles classified as cars to those classified as trucks.

The Steady Rise of Light Trucks

The rise in light truck sales started in the 1980s and has progressed in several waves. First was the introduction of the minivan in 1984, followed by the modern SUV beginning around 1989 and increasing rapidly throughout the 1990s. A growing popularity of various "crossover" vehicles, with designs that blend the traits of traditional body styles, has been the most recent trend. Examples of crossovers include car-based SUVs—such as sport wagons, which once might have been called station wagons—as well as minivan/SUV combinations and pickup/SUV blends.

Automakers are classifying nearly all of these new designs as trucks in order to ease their compliance obligations with CAFE standards. Because light trucks are held to a lower standard—20.7 miles per gallon (mpg) as of model year 2003, compared to 27.5 mpg for cars—this strategy helps in several ways. Simply moving a vehicle from a car fleet to a truck fleet subjects it to a lower standard. Then, because vehicles that were once cars or

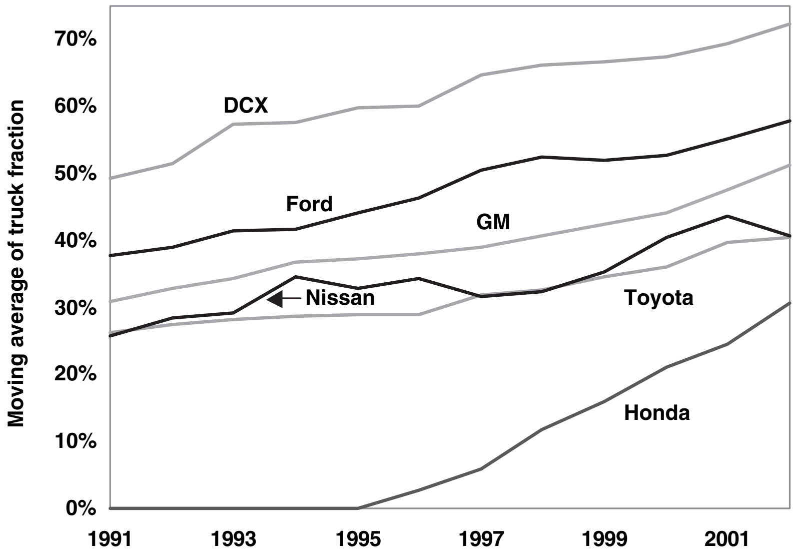

FIGURE 5-4. Light truck fractions of Big Six sales, 1990–2003. *Source:* DeCicco et al. (2005) as derived from National Highway Traffic Safety Administration (2005).

derived from cars are generally more fuel efficient than trucks, the averaging approach on which CAFE is based enables an automaker to sell more of the large trucks on which profit margins have been so high. Finally, because vehicles shifted into the truck category are typically less efficient than the average car, the company's remaining cars can more easily meet the car standard.

Since 1988, when new fleet fuel economy peaked, the market share of vehicles classified as light trucks has climbed from 30 to 51 percent. It is this shift that largely accounts for the 7 percent increase in new fleet-average CO_2 emissions rate over this period. Truck fractions of new vehicle sales have been climbing for all major automakers and there is no sign that the car-to-truck shift had saturated as of 2003. All of the Big Six have rising truck fractions, as shown in Figure 5-4. DCX has the highest fraction of trucks in its fleet and Honda's truck fraction has been growing most rapidly. The overall truck share has been growing in an essentially linear fashion since 1980, when it was only 17 percent. Extrapolating the average gain of 1.5 percentage points per year would put the new light truck share at 60 percent by 2010.

The fuel economy of trucks relative to cars declined, even as truck sales share rose. The main reason for this disparity was the fact that CAFE standards for light trucks were raised much less than those for cars. The result has been a rising excess of light truck CO_2 emissions rates over that of cars, as shown in Figure 5-5. In 1975, when fuel economy recordkeeping

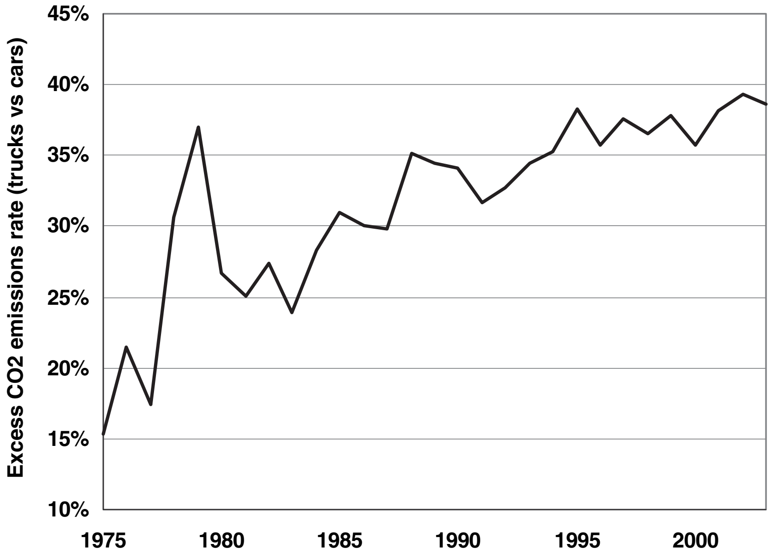

FIGURE 5-5. Excess CO_2 emissions rate of light trucks over cars, 1990–2003. *Source:* DeCicco et al. (2005) as derived from Hellman and Heavenrich (2004). *Notes:* Excess CO_2 emissions rate is defined as the percentage by which the average new light truck CO_2 emissions rate exceeds that of new cars.

started and trucks were in fact much more utilitarian in design and use, the average light truck emitted just over 15 percent more CO_2 per mile than the average car. In 2003, light trucks on average emitted 39 percent more CO_2 per mile than cars. Therefore, light trucks accounted for 59 percent of the new fleet carbon burden in 2003, disproportionately more than their 51 percent sales share. If the trucks that have substituted for cars during the period of market shift had met the passenger car CAFE standard, U.S. automobiles would have consumed 536,000 fewer barrels per day of gasoline and emitted 20 MMTc per year less carbon as of 2003.

Flexible Fuel Vehicles

The Alternative Motor Fuel Act of 1988 (AMFA) established incentives for automakers to sell dual-fuel vehicles, including FFVs, by earning credits applicable to meeting CAFE standards. Most FFVs have been designed to burn a blend of 85 percent ethanol and 15 percent gasoline (E85). For the purpose of CAFE calculation, such an FFV's E85 fuel economy is defined as the value measured on a test run with E85 divided by 0.15—that is, it represents only the number of miles per gallon of the petroleum-derived portion of the fuel. The CAFE calculation further assumes that the FFV operates on E85 50 percent of the time, burning gasoline the other 50 percent of the time. The net result is that an FFV's fuel economy is counted as being a factor of roughly 1.65 times its fuel economy on gasoline. For example, an 18 mpg Chevy Tahoe FFV has its fuel economy tallied as roughly 30 mpg for purposes of calculating GM's light truck CAFE compliance. Because FFVs rarely if ever burn E85, this crediting inflates an automaker's compliance fuel economy and enables the firm to sell less fuel-efficient vehicles while still meeting the standard. The result is higher gasoline consumption and higher CO_2 emissions than if FFV credits were not used.

Each of the Big Three has been making increased use of FFV credits. In GM's case, the credits pushed the company's combined car and light truck CO_2 emissions rate 2 percent higher than it would otherwise have been in model year 2003. Ford makes the most extensive use of FFV credits to date, inflating its combined CAFE by an estimated 1.1 mpg in 2003 and making its new fleet-average CO_2 emissions rate 3 percent higher than if it had met CAFE standards without credits. More extensive use of FFV credits inflated DCX's 2003 combined CAFE by 1 mpg, pushing its average CO_2 emissions rate 4.4 percent higher than it otherwise might have been. None of the Asian or other automakers have exploited this dysfunctional aspect of federal policy to date.

A 2002 report to Congress foresaw the increases in petroleum consumption and CO_2 emissions resulting from the FFV credit policy (U.S. Department of Transportation, 2002). Nevertheless, the FFV credits were subsequently extended by Congress under the Energy Policy Act of 2005, which also provided mandates and other incentives for greatly expanding the availability of ethanol fuel. Future analysis will be needed to assess whether enough ethanol fuel with certifiably low CO_2 emissions will be sold to offset the emissions increases that have already been caused by the use of FFV credits to date.

HEVs in Context

For many observers, the introduction of HEVs has been among the most exciting and hopeful trends to emerge in the auto market from an environmental perspective. Toyota pioneered the technology with the Prius, introduced in Japan in late 1997 and first sold in the United States in 2001. The company has subsequently introduced hybrid electric versions of its Lexus RX series and Highlander SUVs, and has announced ambitious plans for widespread availability of HEVs throughout its product lineup. Honda was first to market HEVs in the United States with its Insight in 2000. The Civic Hybrid was introduced in the spring of 2002 as an early model year 2003 vehicle. Subsequently, Honda introduced a hybrid electric version of its Accord sedan. Ford was first to market with a hybrid SUV, the Escape Hybrid, in model year 2005. GM has produced and sold limited numbers of hybrid electric versions of its Silverado and Sierra pickup trucks. All major automakers have now announced plans for expanded HEV models over the next few years.

HEV sales were still very small in 2003. However, the initial models offered provide a basis of comparison regarding the fuel savings and CO_2 emissions reductions that might be seen through greater use of the technology. Since all of the Big Six automakers have seen their fleet average CO_2 emissions rates increase due to rising light truck sales fractions, it is instructive to compare the likely impact of HEVs in lowering CO_2 emissions rates to the increase in emissions already caused by the car-to-truck shift.

For example, to compensate for its 2.9 percent increase in fleet-average CO_2 emissions rate over the period from 1990 through 2003, Toyota would have to sell 150,000 HEVs that achieve the same average fuel savings as the Prius and Lexus RX400h, or 8 percent of its total sales at 2003 volumes. This is quite likely given Toyota's announced plans, and it may become the first company to offset its truck-driven carbon burden increase by using HEVs. This achievement, however, would only trim its fleet average CO_2 emissions rate to what it was in 1990.

To take another example, Honda had a 5.7 percent increase in its fleet-average CO_2 emissions rate from 1990 through 2003. To compensate for that impact, Honda would have to sell over 300,000 HEVs, or 22 percent of its 2003 sales, with the same average fuel savings as the Civic and Accord Hybrids. Similarly, Ford would have to sell over 650,000 HEVs, or 20 percent of its 2003 sales, with the same average fuel savings as the Escape Hybrid in order to compensate for the 7.7 percent increase in its fleet-average CO_2 emissions rate, due mainly to its shift to trucks compounded by its use of FFV credits.

Reducing Automotive Carbon Burdens

Many actors are involved in the decisions that determine what kind of cars are built and sold, how much they are driven, and how they are fueled. Thus, cutting the carbon burdens of cars is a shared responsibility, though the auto industry is a dominant player.

The past several years have seen shifts in automakers' public positions on global warming. Not long ago, many automakers, particularly the Big Three, denied that a problem existed and carried out campaigns to undermine U.S. support for climate protection actions. Now, all firms profess a desire to help solve a very real problem. In 1998, major automakers made voluntary agreements with the European Union to cut their fleet-average CO_2 emissions rates. A recent report, *Mobility 2030*, endorsed by the Big Six companies in the U.S. market plus Renault and Volkswagen, recommended a goal of limiting GHG emissions to sustainable levels (World Business Council for Sustainable Development, 2004). Automakers have started reporting emissions from their fleets and factory operations and they now regularly publicize new technologies and other activities promising emissions reductions.

Nevertheless, automakers have yet to make significant progress in cutting CO_2 emissions in the United States, the world's largest auto market. With few exceptions, their strategies have made emissions worse. Major product trends, such as the shift to light trucks, have been driving CO_2 emissions rates higher. Some policies rationalized under the guise of reductions, such as the FFV credits, are actually aggravating the adverse CO_2 emissions trends as well as increasing U.S. oil consumption. Although HEVs offer a ray of hope, assessing their influence using the metric of fleetwide carbon burden indicates that any one technology, even an advanced and promising one, can do little to offset broad market trends that continue to push emissions upward.

The missing part of the auto industry's role in cutting carbon burdens is a constructive stance on public policy. Government intervention is essential for resolving the inherent tension between market forces and nonmarket concerns such as global warming and energy security. As this analysis has shown, technology strategies alone are unlikely to address the auto sector's CO_2 emissions problem. Automakers need to embrace balanced but meaningful regulation in order to be true to their promises to address these public concerns. There is no other way to break out of the competitive box that binds product strategies and design priorities to offering consumers almost every variation imaginable, but doing very little to address the huge, nonmarket problems of global warming and oil dependence.

Automakers rightly point out that lack of customer interest is a barrier to higher fuel economy, in contrast to when CAFE standards were established during the oil crisis in the 1970s. Indeed, an extensive public education effort to make fuel efficiency matter more to consumers is needed as part of a broader public strategy to realign market signals and establish U.S. leadership in addressing oil consumption and global warming. The auto industry's cooperation and expertise could help guide such endeavors, but effective steps seem unlikely until automakers take a more positive approach in helping establish a binding U.S. greenhouse gas reduction policy. A good faith effort on the industry's part would open the door to developing more comprehensive solutions for the cars versus climate challenge.

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