Automaker Rankings:
The Environmental Performance *of* Car Companies

Just six companies are responsible for over 90 percent of emissions from America's most polluting product, the automobile. These manufacturers, which rank among the largest corporations in the world, lie at the intersection of corporate responsibility and environmental protection.

Auto industry executives have expressed growing concern for issues like global warming in recent years, and several have vowed to transform their industry to address key threats to our health and environment. Is the industry focusing on environmental concerns in word only, or is it really improving the product it sells?

This report helps to separate the hype from the hardware by using government data to quantitatively determine which automakers are the greenest based on the vehicles they actually sell in their showrooms. We hope that our ranking will help automakers go beyond corporate policy statements to taking meaningful steps to reduce the pollution impacts of the vehicles on America's streets and highways.

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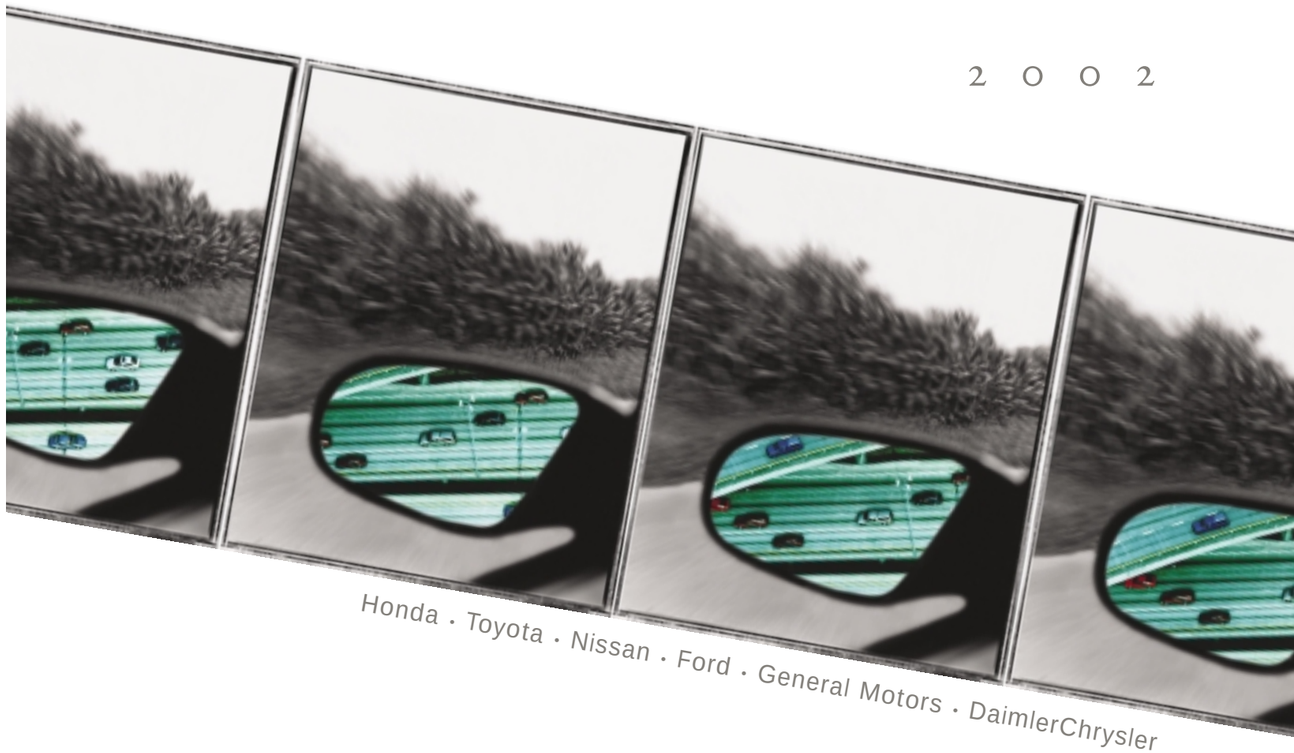

Honda • Toyota • Nissan • Ford • General Motors • DaimlerChrysler

Union of Concerned Scientists

Automaker Rankings:

The Environmental Performance *of* Car Companies

by Jason Mark

Union of Concerned Scientists
September 2002

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The Union of Concerned Scientists is a nonprofit partnership of scientists and citizens combining rigorous scientific analysis, innovative policy development and effective citizen advocacy to achieve practical environmental solutions.

The Union of Concerned Scientists Clean Vehicles Program develops and promotes strategies to reduce the adverse environmental impacts of the U.S. transportation system.

More information about the Union of Concerned Scientists is available on the UCS website at http://www.ucsusa.org.

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Executive Summary

Just six companies are responsible for over 90 percent of emissions from America's most polluting product, the automobile. These manufacturers rank among the largest companies in the world, and lie at the intersection of mounting concerns over corporate responsibility and environmental protection. This report relies on government data to quantitatively analyze which automakers are the greenest, moving beyond board room statements to evaluate what each of the Big Six automakers is actually selling in its showrooms.

We focus on the cars, SUVs, minivans, and pickups sold by the six largest companies in the US market, analyzing their emissions of smog-forming pollutants and global warming gases. Based on the relative emissions of the average new vehicle sold by each company, we then rank the automakers from cleanest to dirtiest, placing equal weight on their contribution to smog and global warming.

Ranking Results

UCS first undertook this study two years ago, analyzing emissions for model year 1998 (MY98) vehicles. This report evaluates vehicles sold in 2001 (MY01), the most recent model year for which data are publicly available, as well as model year 2000 (MY00) for comparison purposes. We found that the pollution ranking of the automakers has remained relatively constant since MY98, with one notable exception: Although still dirtier than the average, Ford has overtaken General Motors as the greenest of the Big Three as a result of its voluntary commitment to build trucks with lower smog-forming emissions.

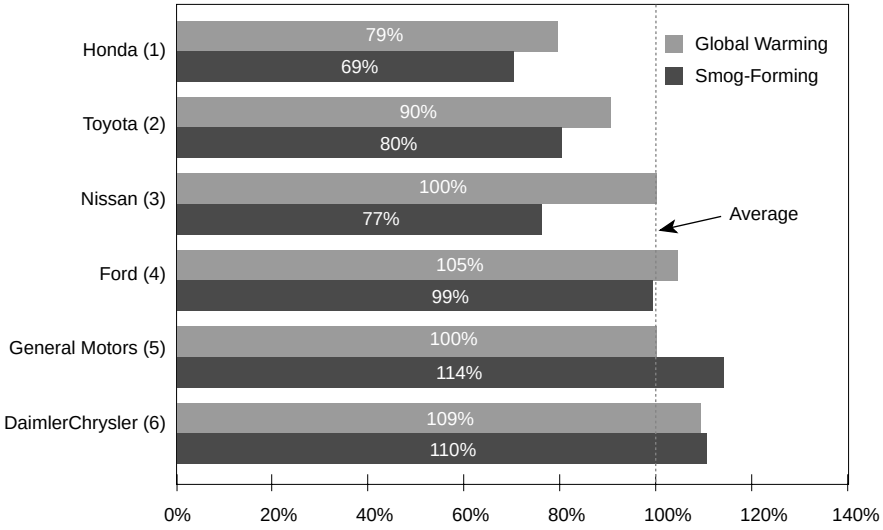
Automaker Pollution Ranking for Average New-Vehicle Emissions

Rank	Model Year 1998	Model Year 2001
1	Honda	Honda
2	Toyota	Toyota
3	Nissan	Nissan
4	General Motors	Ford
5	Ford	General Motors
6	DaimlerChrysler	DaimlerChrysler

Our quantitative comparison of emissions indicates that not all automakers are equal when it comes to the environmental performance of their products. The average new vehicle sold by Honda in MY01, for example, emitted 21 percent less global warming gases and 31 percent less smog-forming pollution than the average for the Big Six automakers. In contrast, DaimlerChrysler's average MY01 vehicle was 9 to 10 percent dirtier.

Technology differences between cars and trucks are an important factor in our rankings. Current environmental regulations permit trucks to pollute more than cars. As a result, the average MY01 truck emitted 2.4 times more smog-forming pollution and 1.4 times more global warming gases than the average MY01 car. Companies with sales dominated by trucks are generally dirtier; however, there are important exceptions. Both Nissan and Ford are ranked above GM in our analysis—despite the fact that they sell more trucks than cars—because their trucks have lower smog-forming emissions.

Model Year 2001 Average Emissions of
Global Warming Gases and Smog-Forming Pollutants



Emissions vs. Big Six Average

High truck sales do not have to be an environmental liability.

Improving Pollution Performance

Ample technology exists to cost-effectively reduce emissions of smog-forming pollutants and global warming gases. Future regulations will require all passenger vehicles to meet the same smog-forming emissions standards by MY09, but there are no significant engineering barriers to accomplishing this sooner. Several recent studies have further demonstrated that off-the-shelf technologies can reduce global warming pollution from both cars and trucks while saving consumers money at the pump. Incorporating these technologies into their product plans will yield much needed improvements in public health and environmental quality.

Automaker Action. Decisions about the environmental impact of US cars and trucks are concentrated in the hands of just a few corporations. Ford's commitment to cleaner trucks, and its resulting rise in our ranking, is proof positive that automakers can improve their pollution performance through voluntary action, although continued leadership is needed to maintain their edge. Unfortunately, Ford's more visible commitment to boost SUV fuel economy will mean little if these gains continued to be swamped by increasing sales of inefficient pickups elsewhere in their fleet.

Companies that continue to lower emissions of smog and global warming gases will climb the green rankings. For example, if Ford committed to not only make its trucks cleaner than required by law, but actually as clean as its cars, it would reach second place in our ranking. If it further extended its SUV commitment to all its trucks and achieved a 25 percent fuel economy improvement, it would be tied with Honda for first place.

Key Results, by Automaker

Honda is the cleanest car company by a large margin. It sells the fewest dirty trucks, and it is also market leader on fuel economy, a key determinant of a vehicle's greenhouse gas emissions. The fuel economy of Honda's compact cars, for example, is 10 miles per gallon higher than that of DaimlerChrysler's, on average. However, Honda's lead in the rankings has slipped in recent years as new tailpipe standards have forced the competition to catch up on smog-forming emissions. The company has also failed to bring efficient technology to its expanding truck market. From MY00 to MY01, the fuel economy of the average Honda SUV dropped by 5 percent.

Toyota is firmly in second place. It is the only automaker to have reduced its fleet average global warming gas emissions from MY00 to MY01, despite a continued shift to trucks and, in particular, to larger trucks. Toyota's truck sales have caused the company to fall behind Nissan on smog-forming emissions because Toyota's larger trucks are built to a less stringent environmental standard.

Nissan, which had fallen to fourth place behind Ford in MY00, regained third place in MY01 as it was forced to meet new tailpipe standards for smog-forming pollution. Nissan's strength on smog emissions is substantially offset by its poor performance on global warming gas emissions. Nissan's most popular cars and truck models are consistently among the least fuel-efficient vehicles in many size classes, and the company has been the most aggressive in shifting to truck sales in recent years.

Ford, which rose from fifth place in MY98 to third in MY00, slipped back to fourth by MY01. The primary reason Ford moved in the rankings was its commitment to meet tighter smog-forming pollution standards for its trucks. Ford's biggest trucks average 20-25 percent lower smog-forming emissions than GM's, although both companies' trucks are still several times dirtier than their cars. In contrast, Ford's global warming gas performance is lackluster. Both its cars and trucks are less efficient than the average and, in many size classes, Ford's most popular models have the lowest fuel economy in the industry. Ford does appear to be on the way to meeting its commitment to boost SUV fuel economy by 25 percent from MY00 to MY05. Its SUV fuel economy improved by 4.8 percent in the first year, exclusively through sales of smaller, more efficient SUVs (e.g., the Escape). However, Ford's SUV gains were largely offset by the declining fuel economy of its pickups, making its overall truck fuel economy improvement only 0.8 percent.

General Motors continued to move into the dirty large-truck market. Had GM matched Ford's commitment to build lower-emitting trucks, it would have retained fourth place in our rankings. GM's most popular large trucks are more fuel efficient than the competition, but its continued efforts to sell the largest vehicles harms its overall global warming gas performance. Indeed, GM's truck fuel economy appears to have fallen behind that of Ford's for the first time in several years.

DaimlerChrysler continues to be in last place. In both the car and truck categories, its vehicles are typically dirtier. However, it's DC's intense focus on truck sales that keeps it at the bottom of the rankings. From MY00 to MY01, DC's global warming gas emissions increased more than those of any other automaker, despite the fact that DC was also the only company to reduce its reliance on trucks. DaimlerChrysler is also the most aggressive automaker in exploiting loopholes in fuel economy laws that permit vehicles built to run on ethanol (but which almost never do) to receive inflated fuel economy ratings. In MY01, they sold nearly 200,000 Dodge Caravans that got 24 mpg when running on gasoline, but which the government recorded as getting 39 mpg.

Policymaker Action. Thirty years of motor vehicle policy experience remind us that we cannot rely on automaker good will to deliver much needed health and safety protection across the industry. While new tailpipe rules will eventually require all cars and trucks to meet the same, lower standard for smog-forming emissions, policymakers should begin crafting new regulations to deliver additional air quality improvements and protect public health.

Policymakers have moved more slowly to address both the global warming gas emissions and oil consumption of motor vehicles. Loopholes persist in current rules that must immediately be closed, but new policies need to be put in place to take advantage of the tremendous opportunities available through existing and future automotive technologies to improve the industry's environmental performance.

Automakers and the Environment

The auto industry lies at the intersection of growing concerns over environmental protection and corporate responsibility. The six companies that dominate the US car market—General Motors, Ford, DaimlerChrysler, Toyota, Honda, and Nissan—were ranked in the top 60 of the global *Fortune* 500, with worldwide revenues exceeding $700 billion in 2001 despite the general economic downturn (*Fortune* 2002).[1] Their sheer size makes these companies important contributors to the world economy, but the environmental impact of their products makes them stand out.

Industry executives have expressed growing concern for issues like global warming in recent years, and several have vowed to transform their industry to address key threats to our health and environment. There is no doubt that the global auto industry is focusing on environmental concerns, but is it in words only, or is it improving the actual products it sells? This report helps separate the hype from the hardware by evaluating the environmental performance of automakers based on actual sales. Our analysis focuses on the largest six automakers in the US market, which together account for nearly 9 out of every 10 vehicles sold in America. We evaluate key pollutants from each company's passenger vehicles and compare them based on the average vehicle they sell as well as key market segments (e.g, SUVs or subcompacts). Ultimately we hope our ranking will help automakers go beyond corporate policy statements by providing guidance on the most meaningful steps they can take to reduce the pollution impacts of their products.

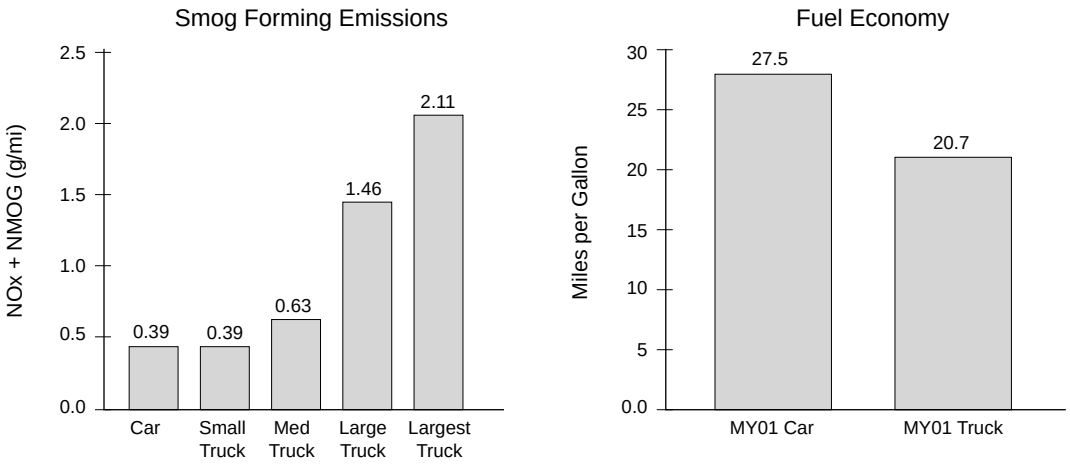
Passenger Vehicle Pollution

Despite significant strides in reducing tailpipe pollution, automobiles still pose a serious threat to American's health and environment. The past three decades have seen significant progress in reducing the per-vehicle emissions of key pollutants, but the benefits obtained from new vehicle regulations have been tempered by the growth in vehicle travel and a shift toward larger, more polluting vehicles. There are now 10 percent more passenger vehicles registered in the United States than people licensed to drive, and the total number of miles driven has more than doubled since 1970 (Davis 2000). The rise of SUVs and other light trucks—which now account for over half of all sales—has had a particularly important impact on both air pollution and fuel use, since these vehicles are not held to the same standards as the cars they replace. A new truck meeting today's emissions standards is allowed to emit up to five times the smog-forming pollutants of a new car.[2] And trucks are permitted to burn one-third more fuel than cars, on average.

[1] GM, Ford, DaimlerChrysler, and Toyota alone are among the top ten largest companies in the world.

[2] By 2009, the so-called Tier 2 regulations will require that all vehicles meet the same average emissions standard, equal to 0.16 g/mi (NOx + NMOG) at 120,000 miles.

MY01 Environmental Standards for Cars vs. Trucks



Notes:

1. Smog-Forming emissions are the sum of the 100,000-mile standard for NOx and NMOG. Car, small truck, and medium truck correspond to the National Low Emission Vehicle (NLEV) program. Large and largest truck emissions are not captured by NLEV, so the default Tier 1 standards apply. Size definitions for trucks are based on vehicle weight in pounds (lbs), as follows: small (3750 lbs LVW, 6000 lbs GVWR); medium (>3750 lbs LVW, 6000 lbs GVWR); large (5750 lbs adjusted LVW, 8500 lbs GVWR); largest (>5750 lbs adjusted LVW, 8500 lbs GVWR). LVW = loaded vehicle weight (curb weight plus 300 lbs); GVWR = gross vehicle weight rating (maximum design loaded weight specified by the manufacturer).
2. The definition of car and truck are not identical for smog-forming emissions standards and fuel economy. For example, the DaimlerChrysler PT Cruiser is classified as a car for emissions regulations, whereas it is a truck under fuel economy regulations.

Smog. The key ingredient in urban smog, ground-level ozone, is formed when nitrogen oxides and hydrocarbons combine in the presence of sunlight. Ozone causes a variety of short-term health effects in the lungs, including irritation of the respiratory system, reduction of lung function, asthma aggravation, as well as inflammation and damage to the lining of the lung. These effects may cease when ozone levels fall, but repeated short-term damage from ozone exposure may permanently injure the lung (ATS 1996). Over 118 million Americans (42 percent) still live in 266 cities that exceed current federal health guidelines for smog levels.[3] Passenger vehicles are responsible for one-fifth of the primary smog-forming emissions nationwide. In key smog-choked cities, however, passenger vehicles are an even more important source. For example, one-third of the smog-forming emissions emitted in the Los Angeles region come from cars and light trucks.[4]

Global Warming. With each passing year, the scientific consensus continues to grow. Not only is the earth's surface temperature increasing due to human activity, but the consequences for our health, environment, and economy will be serious (Goetze and Farnsworth 1998). Passenger vehicles alone emit 20 percent of the US carbon dioxide (CO_2) emissions, the chief heat-trapping gas. US passenger vehicles account for more CO_2 emissions than all but three entire countries

[3] Data for ozone nonattaiment areas as of July 29, 2002 from EPA's Greenbook (http://www.epa.gov/oar/oaqps/greenbk/ancl3.html).

[4] NOx + ROG (Reactive Organic Gas) emissions for the South Coast Air Quality Management District for 2001 (www.arb.ca.gov).

in the world.[5] The Corporate Average Fuel Economy (CAFE) standards, designed in 1975 to address the economic risks posed by America's oil dependence, have also helped curb heat-trapping emissions from motor vehicles. CO_2 emissions from passenger vehicles would be 50 percent higher today if it were not for CAFE standards (Friedman et al 2001). Unfortunately, fuel economy standards have been virtually unchanged from the levels originally envisioned in 1975. A combination of stagnant standards, growing sales of light trucks (which are held to a less stringent standard), and rising travel means that greenhouse gas emissions from passenger vehicles over the coming decades will grow faster than at any time in recent history.[6]

Analytical Approach[7]

Many studies have been done over the years to the evaluate pollution from motor vehicles, and there are several recent and on-going efforts to compare vehicles and companies on environmental grounds. For example, the American Council for an Energy-Efficient Economy (ACEEE) publishes a Green Guide to Cars and Trucks annually, which offers the most comprehensive and accurate comparisons between individual models.[8] It is the recommended source for vehicle purchasers who want to understand the impact of their buying decision.[9]

In 2000, UCS published the first-ever ranking of the automakers based on their average pollution performance (Morey et al 2000). Whereas the ACEEE ratings allow prospective buyers to compare individual vehicles, this study (which updates our previous 2000 analysis) offers policymakers, industry, and the public an objective comparison of the pollution performance of the average vehicle sold by each automaker. Our goal is to identify how automakers compare when it comes to overall pollution performance and what steps they could take to increase environmental stewardship.

To understand the impact that each automaker's average sales has on the environment, our study focuses on two key problems: smog-forming pollution and global warming. The impact of passenger vehicles goes far beyond these two environmental concerns—including water pollution, land use issues, congestion, and other social problems. However, we focus on issues where passenger vehicles have a unique and significant impact on public health and the environment.

We rely on several government databases to develop our rankings, focusing on MY01, which is the most recent year for which data are publicly available. Using sales estimates and certification standards for smog-forming emissions and fuel economy, we then calculate sales-weighted average emissions rates for smog-forming and greenhouse gas emissions by manufacturer (as well as for certain market segments like cars vs. trucks). The resulting grams-per-mile values represent the emissions from each automaker's average vehicle.[10] We first rank each automaker on smog-forming and greenhouse gas emissions separately and then combine the two classes of pollutants to develop an overall ranking, giving equal weight to each.

[5] Only the total emissions from all sources in China, Russia, and Japan exceed those of US passenger vehicles (DeCicco and An 2002).

[6] During the period 1975 to 2000, greenhouse gas emissions rose at an annual average rate of 1.0 percent, whereas future emissions are forecast to rise at 2.2 percent per year through 2020 absent new global warming or fuel economy standards (Friedman et al 2001).

[7] See Appendix A for a complete discussion of the scope and methodology.

[8] See www.greenercars.com.

[9] The Environmental Protection Agency separately publishes a Green Vehicle Guide electronically that allows users to look up individual vehicles and evaluate their environmental performance, but its information is less complete than that of ACEEE's Green Guide.

[10] The emissions rates calculated in our study are *not* meant to represent real-world emissions, since the certification values used for smog-forming emissions and fuel economy do not represent actual in-use performance. Nonetheless, these estimates allow accurate comparisons *among* vehicles that permit a fair ranking of their environmental performance.

Pollution Performance Results

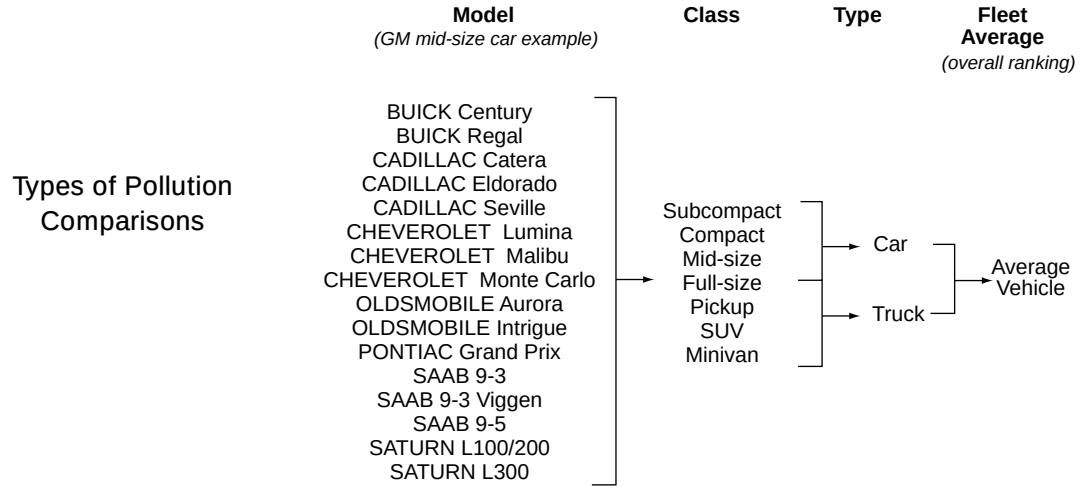
Our study compares automakers' pollution performance in several ways. The primary comparison, and the one that forms the basis of our ranking, evaluates the smog-forming and greenhouse gas pollution emitted from the average vehicle produced by each company. This determines how green each automaker is overall. We also analyze various market segments, comparing companies by car vs. truck, by class, and by most popular models. Finally, we estimate the total pollution impact of each automaker, taking into account their average emissions and total sales.

Fleet Average Comparisons

Morey et al (2000) analyzed pollution performance for MY98. For this study, we analyzed MY00 and MY01, allowing us to compare how each automaker's ranking has changed over time.

Rankings. Over the years analyzed, Ford is the only automaker that has moved in the rankings, rising from fifth place in MY98 to third in MY00, but slipping to fourth by MY01. Although there are several factors involved, the primary reason Ford moved in the rankings was its commitment to meet tighter smog-forming pollution standards for its trucks. In striving to meet that commitment, Ford had passed both GM and Nissan in the rankings by MY00. However, the enactment of new tailpipe standards in MY01 forced cars and small trucks to become cleaner, allowing Nissan to regain third place. Nonetheless, Ford retains its lead over GM because it continues to build large trucks with lower smog-forming emissions.[11]

Smog-Forming Emissions. Our results indicate that there are important quantitative differences



[11] GM does have lower average emissions of greenhouse gases; however, the gap between the companies' smog-forming emissions is much larger, resulting in Ford's higher rank.

Automaker Pollution Ranking for Average New-Vehicle Emissions

Rank	Model Year 1998	Model Year 2000	Model Year 2001
1	Honda	Honda	Honda
2	Toyota	Toyota	Toyota
3	Nissan	Ford	Nissan
4	General Motors	Nissan	Ford
5	Ford	General Motors	General Motors
6	DaimlerChrysler	DaimlerChrysler	DaimlerChrysler

among the pollution performances of individual automakers. In 2001, for example, GM's average vehicle emitted 65 percent more smog-forming pollution than the industry leader, Honda. However, the gap between the worst and the best has narrowed since MY98 as new tailpipe standards have forced all automakers to produce cleaner vehicles. The National Low Emission Vehicle (National LEV) program came into full force in MY01, requiring all cars, and small and medium trucks to meet tighter standards. As a result, other automakers gained ground on Honda and Ford, who had introduced LEV vehicles in segments of their fleet before MY01. Nissan, in particular, saw significant improvements in its emissions performance due to the fact that all of its cars and trucks were subject to the new National LEV program.

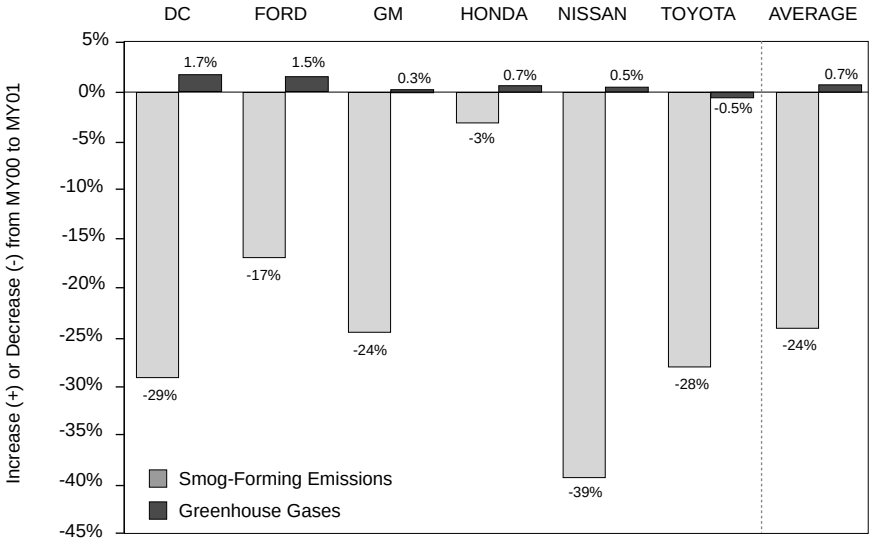
Global Warming Gases. The automakers are less differentiated when it comes to heat-trapping emissions than they are in terms of smog-forming emissions, but large gaps remain. In MY01, DaimlerChrysler's average vehicle emitted 37 percent more greenhouse gases than the industry leader, Honda. The most noticeable shift over the three model years analyzed was the substantial increase in Nissan's greenhouse gas emissions compared to the average. Between MY98 and MY00, Nissan's fleet fuel economy dropped substantially. It not only fell within its car and truck lineups, but the company also continued to shift its market away from cars and toward less-efficient trucks. Nissan's MY98 fleet fuel economy was 27.1 mpg, whereas its MY01 value was 23.9 mpg.

Emissions vs. "Big Six" Average, by Model Year

Automaker	Smog-Forming Emissions			Greenhouse Gas Emissions		
	MY98	MY00	MY01	MY98	MY00	MY01
DC	113%	118%	110%	109%	107%	109%
Ford	107%	90%	99%	106%	104%	105%
GM	102%	115%	114%	99%	100%	100%
Honda	59%	54%	69%	78%	79%	79%
Nissan	86%	96%	77%	90%	100%	100%
Toyota	85%	85%	80%	88%	91%	90%

Year-to-Year Trends. We are unable to directly compare smog-forming emissions with the original study for MY98, since this analysis focuses on 100,000 mile certification standard and the original on 50,000 mile levels. However, we can see important trends in emission rates between MY00 and MY01. In particular, our analysis indicates that smog-forming emissions dropped

Change in Average New-Vehicle Emissions from MY00 to MY01



by 24 percent in one model year, largely due to the National LEV program. As noted above, some automakers made larger gains than others. Nissan's smog-forming emissions dropped by 39 percent, whereas Honda and Ford made less progress because they had already shifted large portions of their fleet to the new standards by MY00. Shifts in global warming gases were both much smaller and in the wrong direction. Thus, in stark contrast to progress on smog, the industry continued to lose ground in addressing global warming.

Car and Truck Comparisons

Current environmental regulations permit trucks to pollute more than cars. As a result, the average MY01 truck emitted 2.4 times more smog-forming pollution and 1.4 times more global warming gases than the average car. Those companies whose sales are dominated by trucks are generally dirtier; however, there are notable exceptions. Both Nissan and Ford are ranked above GM in our analysis—despite the fact that they sell more trucks than cars—because their trucks have lower smog-forming emissions.

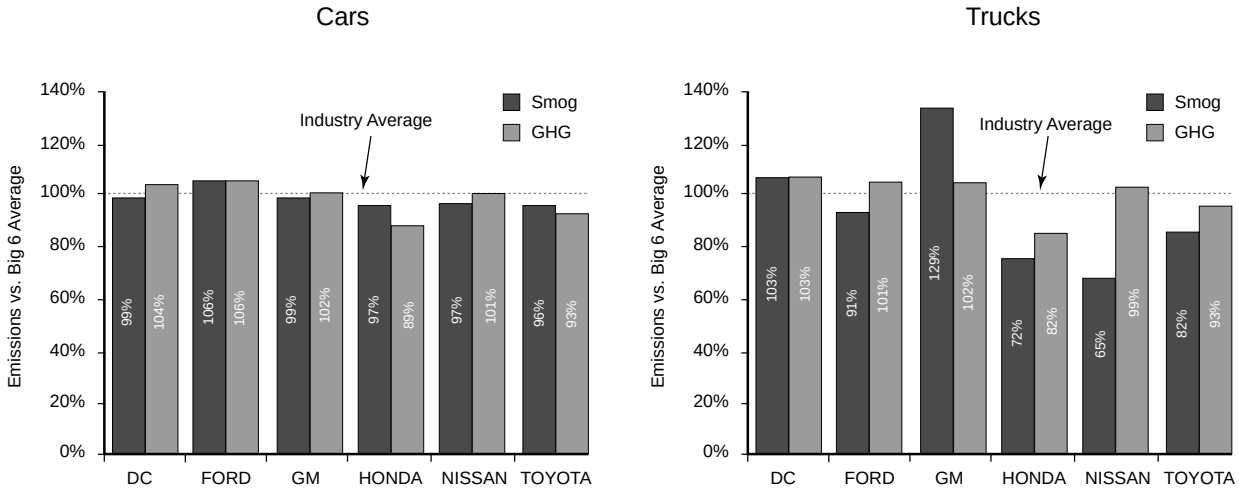
MY01 Average Emissions, by Manufacturer

	Smog-Forming Emissions (g/mi)			Greenhouse Gas Emissions (g/mi)			Truck Share
Automaker	Cars	Trucks	Both	Cars	Trucks	Both	%
DC	0.39	0.96	0.73	408	556	506	66%
Ford	0.42	0.84	0.66	414	547	489	56%
GM	0.39	1.21	0.76	397	551	466	45%
Honda	0.38	0.67	0.45	348	445	369	22%
Nissan	0.38	0.61	0.51	395	537	465	50%
Toyota	0.38	0.77	0.53	365	503	420	40%
Big Six Avg	0.39	0.93	0.66	391	542	466	50%

Notes:

1. Smog-Forming emissions are the sum of the 100,000-mile standard for NOx and NMOG.
2. Greenhouse gas emissions are expressed as CO2-equivalent emissions and include vehicle operation and fuel production and delivery.
3. Truck share is based on EPA sales data for trucks vs. cars.

Emissions vs. Big Six Average, Cars and Trucks



Smog-Forming Emissions. Our analysis indicates that most of the automakers have similar emissions for their cars. Ford's cars are 6 percent dirtier than the average, however, due to substantial sales of higher-polluting Lincoln Continentals, Jaguars, and select Ford Mustangs, Mercury, and Mazda vehicles.

In contrast to their cars, Ford's trucks are better than average, although Nissan's trucks are by far the cleanest. General Motors' trucks are two times dirtier than Nissan's, on average.

Global Warming Gases. As with smog-forming emissions, Ford has the highest polluting cars when it comes to global warming. In calculating heat-trapping gas emissions, we discount the added fuel economy credits that automakers receive for vehicles built to run on alternative fuels (but which almost never do). In 2001, Ford received for the 66,000 MY01 flex-fuel Taurus vehicles under a CAFE loophole.[12] The clear leaders in the car market are Honda and Toyota, the only two manufacturers that produce vehicles whose emissions fall below the average.

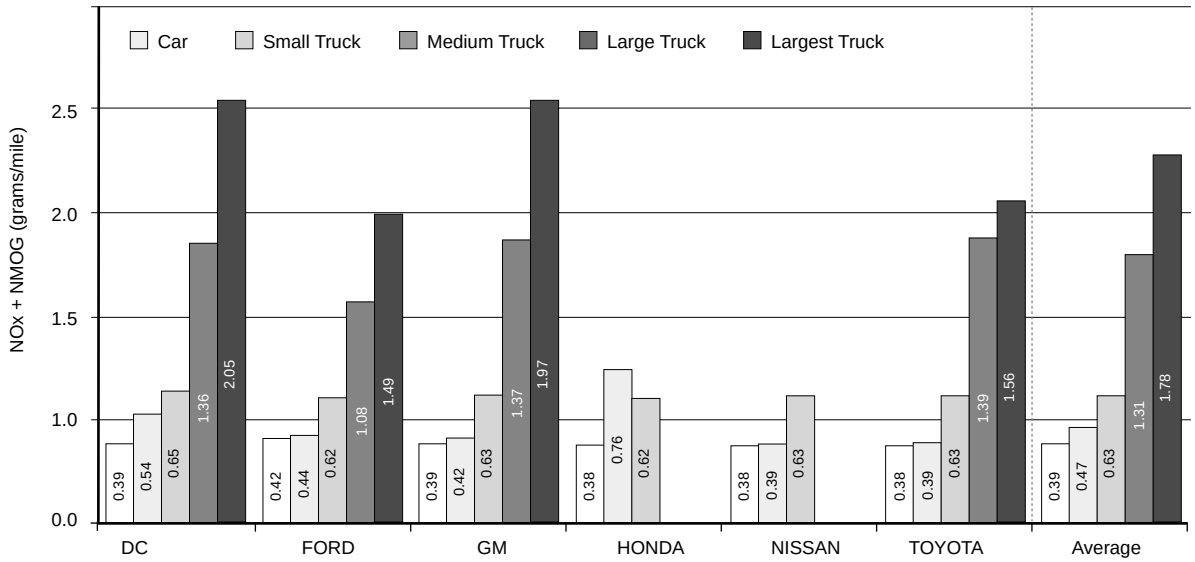
Global warming gas emissions for trucks are remarkably similar among those companies whose sales are dominated by trucks—DC, Ford, GM, and Nissan. Nissan's high heat-trapping gas emissions are particularly surprising given that it does not sell the largest, most polluting trucks. Honda and, to a lesser extent, Toyota continue to lead the pack in terms of low truck greenhouse gas emissions.

Class Comparisons

In addition to the significant gap between cars and trucks, there are important differences between classes of vehicles when it comes to their pollution performance. For example, smog-forming emissions standards are uniform for cars, but trucks face different standards based on their weight; standards for heavier vehicles can be up to five times more lenient than for lighter trucks.

[12] Under federal law, a flex-fuel Taurus is given a fuel economy of 41.6 mpg because of its potential to run on an alternative to gasoline (ethanol). These vehicles rarely operate on alternative fuels in the real world, and thus we assign the gasoline vehicle fuel economy of 25.6 mpg. The net impact is to raise global warming gas emissions of Ford's car fleet by nearly 2 percent.

Car and Truck Smog-Forming Emissions, by Size Class



Notes:

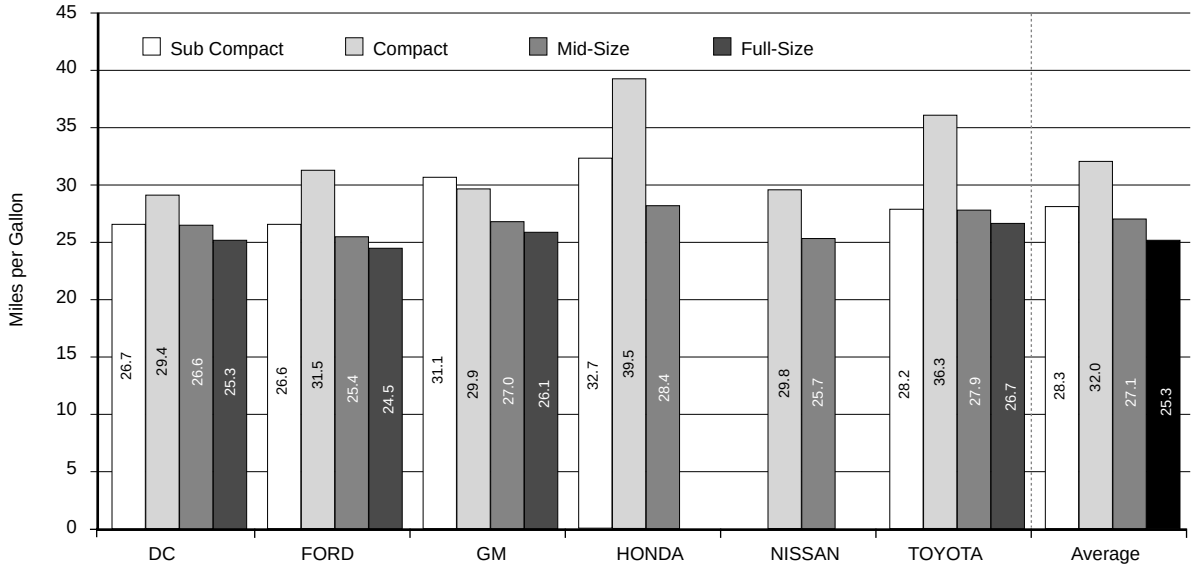
1. Smog-forming emissions are the sum of the 100,000-mile standard for NOx and NMOG.

Smog-Forming Emissions. As noted above, car emission standards are uniform, and thus there are relatively small differences between manufacturers (with the exception noted above about Ford). In the small truck category, which encompasses small SUVs (e.g., Ford Escape) and compact pickups (e.g., Ford Ranger), most automakers' emissions are only slightly higher than for their cars. DaimlerChrysler and Honda are, however, consistently dirtier for the years considered. Particularly surprising given their past commitments to lower emission vehicles is Honda's high-polluting small trucks. Honda's small trucks, which consist entirely of the TLEV certified CR-V SUV, are 60 percent dirtier than the industry average. Honda has corrected the problem in MY02, cutting the CR-V's emissions by nearly five fold to meet the MY04 LEVII standards ahead of schedule.

Most automakers' medium trucks, dominated by sales of mid-size SUVs (e.g., Ford Explorer) and minivans (e.g., Ford Windstar), are relatively similar and are centered around the National LEV average standard of 0.63 g/mi (NOx+NMOG). Differences among the large and largest trucks, which in emissions correspond to pollution from the largest SUVs (e.g., Ford Expedition) and pickups (e.g., Ford F150), are the most significant and drive much of the rankings results. In particular, Ford's commitment to build LEV trucks has meant that their vehicles are 16-18 percent cleaner than the average for their size class. With the largest trucks emitting 4-5 times the pollution of the average car, Ford's clean-air commitment goes a long way to improving their environmental performance for smog-forming pollution.[13]

[13] While Ford's public commitment extended to all their SUVs, a review of the EPA emissions database shows that a small number of SUVs from their Land Rover division did not meet the LEV standard.

Car Fuel Economy, by Class

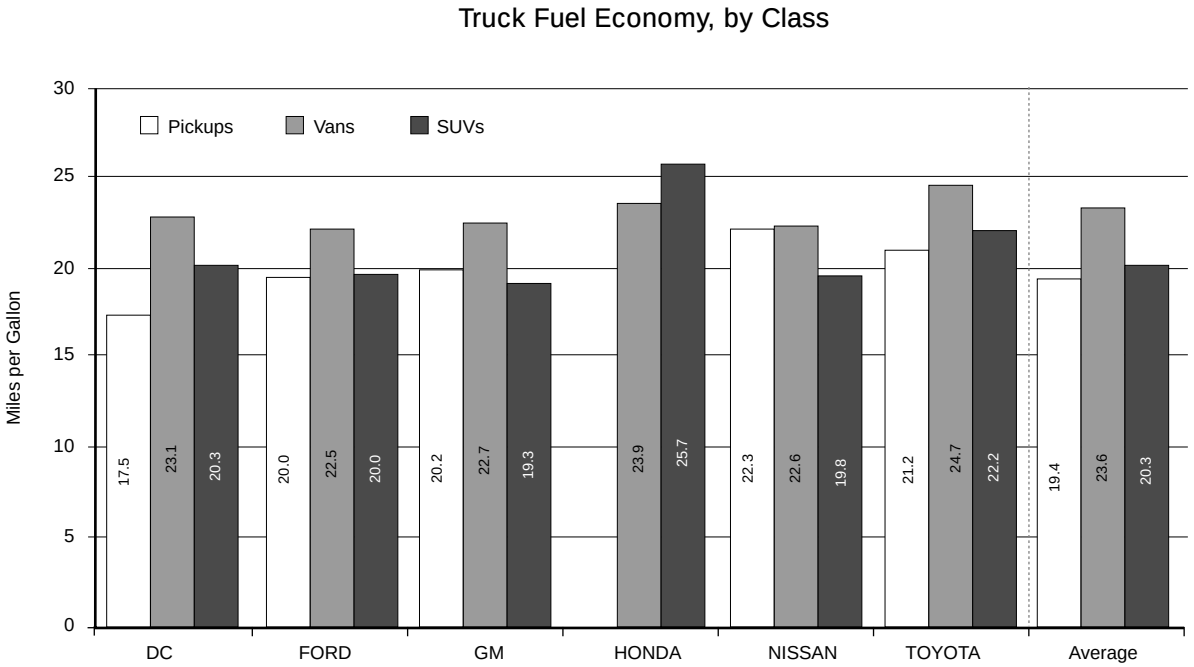


Notes:

1. Fuel economy values are combined city/highway results from CAFE tests. They do not reflect average fuel use during typical driving conditions.

Global Warming Gases. Fuel economy regulations are currently the only policy strategy having a measurable impact on heat-trapping emissions that cause global warming. Thus, to understand the relative global warming impact of vehicles in various size classes, we focus on fuel economy. Higher fuel economy numbers mean fewer emissions of global warming gases. In the car market, the differences between companies is quite significant. For example, the average compact car sold by Honda in MY01 was more than 10 miles per gallon (mpg) more efficient than DaimlerChrysler's. Differences in other size classes are less significant, but Honda and Toyota—the top two companies in our ranking—consistently outstrip the competition in almost every category.

In the truck market, a direct comparison between companies is more difficult because each class (pickup, van, SUV) encompasses a broader array of vehicle models. But again, the top three companies lead the pack on fuel economy: Honda in SUVs, Toyota in vans, and Nissan in pickups. As before, we have eliminated the added credits attributed to flex-fuel vehicles (FFV) sold by the Big Three, since the vehicles do not deliver fuel savings because they almost never run on alternative fuels. The impact of eliminating the FFV credits is more significant in the truck category than with cars, since there were 332,000 FFV trucks sold in MY01 among the Big Three. DaimlerChrysler used the most credits, gaining 0.7 mpg through sales of Dodge Caravan FFVs. Ford gained 0.2 mpg through



Notes:

1. Fuel economy values are combined city/highway results from CAFE tests. They do not reflect average fuel use during typical driving conditions.

sales of FFV Rangers, postal service vehicles, and Mazda B3000 pickups. And GM gained 0.3 mpg by selling FFV Sonoma and S10 pickups.

Comparing the truck fuel economy data to MY00, we are able to evaluate whether Ford is on track to meet its commitment of improving SUV fuel economy by 25 percent by 2005. If Ford were to spread the increases equally over the five years following their announcement in 2000, then one would expect their SUV fuel economy to improve 5 percent per year. Indeed, our analysis indicates that Ford's SUV fuel economy did improve nearly 5 percent from MY00 to MY01. However, Ford did not appear to make progress on SUV fuel economy due to technology improvements, but from a shift to lighter SUVs with higher fuel economy (most notably the Escape). A comparison of models carried over from MY00 to MY01—the Explorer and Expedition—indicates that these vehicles' fuel economy typically got worse, not better. To meet its commitment, Ford will either have to introduce improved technology into its SUV mainstays or continue to shift its sales toward the more efficient Escape and other models. Furthermore, Ford's SUV improvement was offset by reductions in its pickup fuel economy so that its average light truck improved less than 1 percent between MY00 and MY01. Holding all else constant, a 25 percent increase in SUV fuel economy over MY00 levels should yield a 9 percent gain in Ford's truck fuel economy by MY05.

Soon after Ford made its SUV promise, GM stated that it would continue to beat Ford's overall truck fuel economy in 2005. Our analysis for

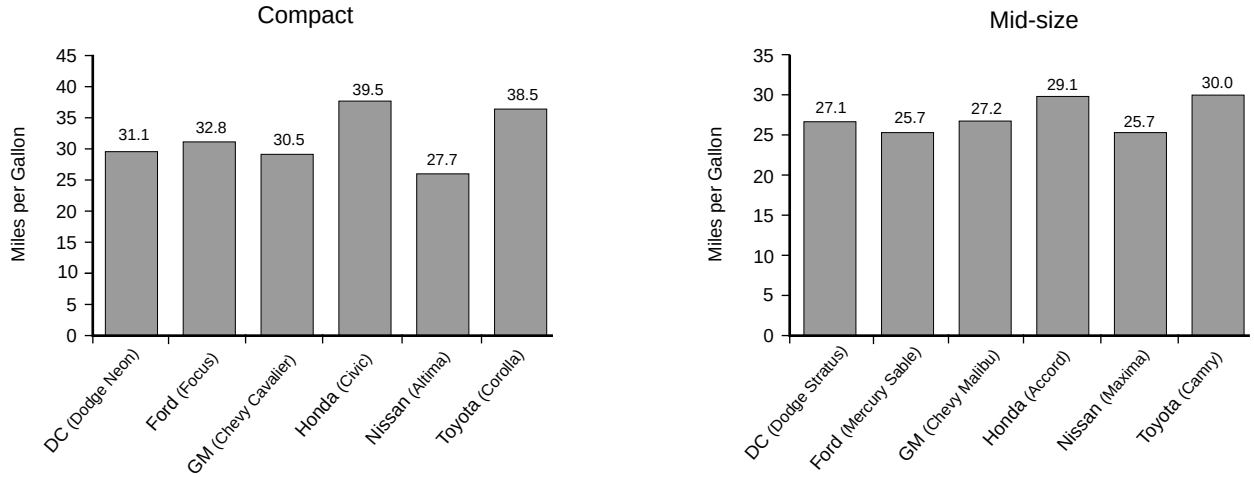
MY01 indicates that GM has already slipped below Ford's average truck fuel economy, when FFV credits are excluded. But even with the FFV credits, GM only matches Ford on truck fuel economy.

Model Comparisons

Our overall rankings are based on every vehicle sold by each automaker. To get an idea of how individual vehicles from each company stack up, however, we undertook an additional analysis comparing specific models. Rather than conduct a full comparison of each of the 290 models and configurations available in MY01, we focused on each automaker's best-selling model in each size class. Unfortunately, the available data do not permit such a comparison for smog-forming pollution, but we are able to identify differences on fuel economy.[14] This analysis helps identify differences in environmental performance of like vehicles. Because we average the fuel economy of various model configurations based on their sales (e.g., six vs. four cylinder), we are able to compare the average vehicles being sold instead of just the best, most efficient vehicles, which may not be produced in large volumes. Furthermore, since we focus only the best-selling models, we are focusing on each company's mainstream offering in each size class, not on vehicles designed for smaller markets.

The complete results for every size class are listed in the Appendix, but several comparisons are worthy of note. In particular, the results confirm that automakers can build fuel efficient vehicles that sell. For cars, Honda and Toyota have the class leaders in both the compact and midsize car categories. The Honda Civic, for

Fuel Economy of the Most Popular Car Models, by Class

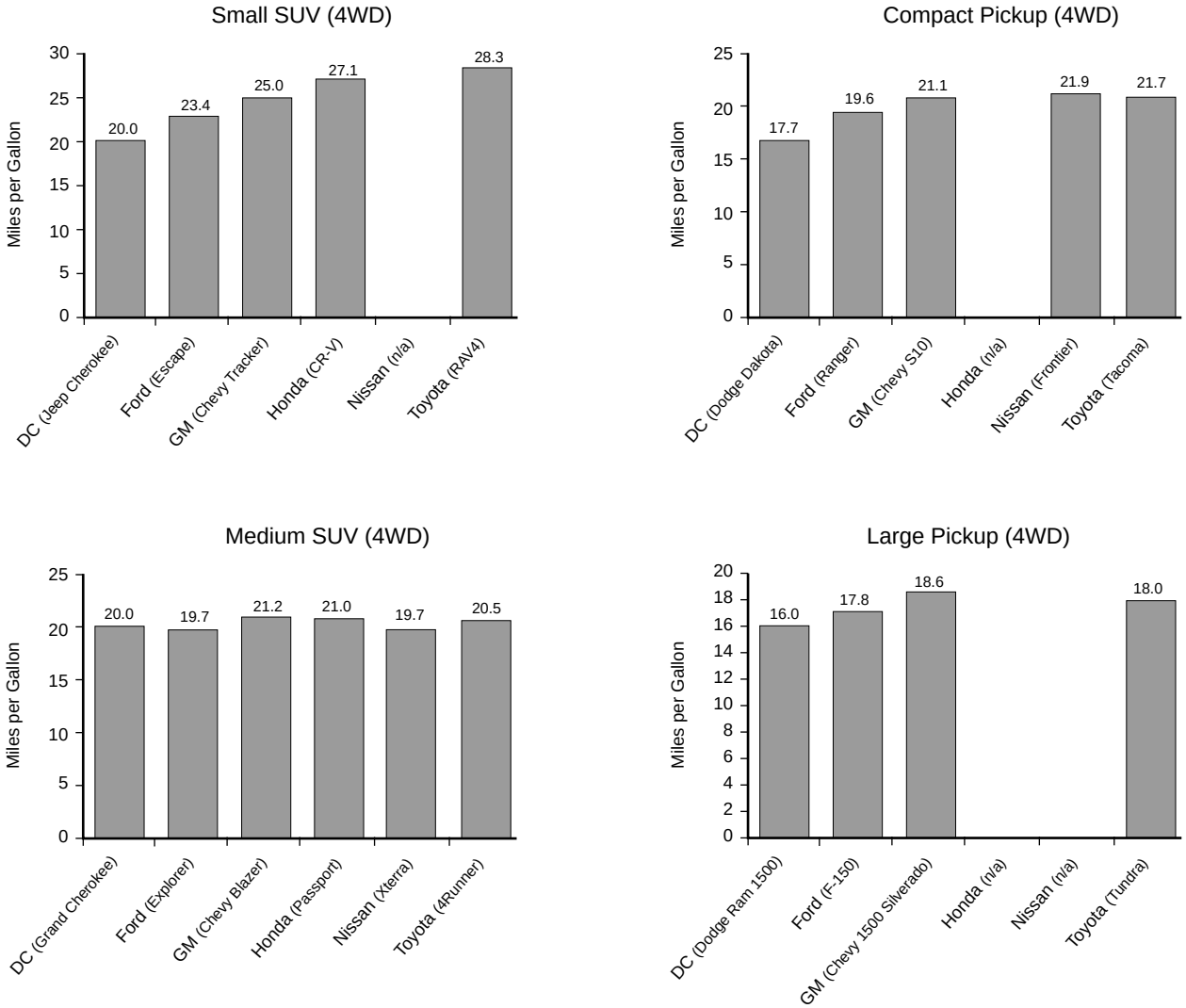


Notes:

1. Fuel economy values are combined city/highway results from CAFE tests. They do not reflect average fuel use during typical driving conditions.

[14] Sales information was only available for whole engine families, which comprise engines that can be used in one of several vehicles (e.g., Ford produces an engine that is put in both the Explorer SUV and the Ranger pickup). Thus, we are unable to develop sales-weighted emissions averages for vehicle models, as we have for fuel economy.

Fuel Economy of the Most Popular Truck Models, by Type

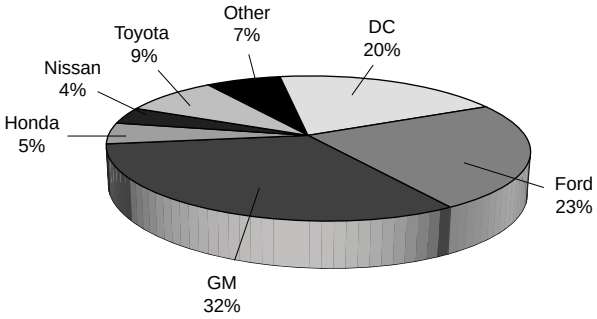


Notes:

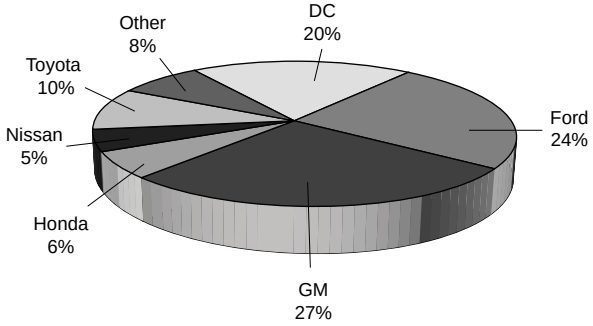
1. Fuel economy values are combined city/highway results from CAFE tests. They do not reflect average fuel use during typical driving conditions.

Total Pollution Impact for MY01 Sales, by Manufacturer

Smog-Forming Emissions



Global Warming Gases



example, is 7.1 mpg more efficient than the Ford Focus, 8.4 mpg more than the Dodge Neon, 9.0 mpg more than the Chevy Cavalier, and 11.8 mpg more than the Nissan Altima (the class laggard). It is also, by far, the most popular vehicle in the compact category. Differences in the mid-size car class are smaller, but Toyota and Honda once again lead the pack. The average Toyota Camry is 4.3 mpg more efficient than either the Mercury Sable or the Nissan Maxima.[15] Again, the most efficient models, the Toyota Camry and the Honda Accord, are the best selling vehicles in their class.

Model comparisons for the most popular trucks produce similar discrepancies among automakers. For example, Toyota's RAV4 SUV is 8.3 mpg more efficient than DaimlerChrysler's Jeep Cherokee. Both are four wheel drive, (4WD). Nissan's Frontier compact pickup truck is 4.2 mpg more efficient than the Dodge Dakota. In the medium SUV category, differences between companies are smaller, but the average 4WD Chevy Blazer outperforms the average 4WD Ford Explorer by 1.7 mpg. The Chevy 1500 Silverado is the most efficient 4WD in the large pickup category, besting the Dodge Ram 1500 by 2.6 mpg.

Across the most popular models of cars and trucks, Honda and Toyota excel on fuel economy. As these companies have increased their shares of the truck market, they have maintained their fuel economy advantage in the smaller vehicles (e.g., small SUVs and compact pickups). In recent years, however, Toyota has begun to offer increasing numbers of large SUVs and pickups that are not class leaders. Should the trend continue, Toyota risks falling in the rankings if it becomes similar to the Big Three in its sales of inefficient and dirty large trucks.

Total Pollution Impact

While automakers clearly differ when ranked on their average vehicle sales, the differences are even larger when considering their total vehicle sales. The Big Three have a disproportionate

[15] The Ford Taurus is classified as a full-size car in EPA's database for MY01.

impact on the environment because their vehicles are dirtier, on average, than the rest of the industries'. But the total impact of GM, Ford, and DaimlerChrysler's vehicle sales is even larger because they build two-thirds of all the vehicles sold in the United States. As a result, the Big Three account for 75 percent of all smog-forming emissions from new vehicles and 72 percent of all greenhouse gas emissions. Because these companies are the dominant polluters in the auto industry, their decisions on the environmental performance of their products have the largest potential impact.

Conclusions

Industry-Wide Results

Each year, the auto industry sells millions of vehicles in the United States that have a heavy toll on our economy, health, and environment. Just a few companies are responsible for the lion's share of the impact, with vehicles from the six largest automakers accounting for 93 percent of all smog-forming pollution and 92 percent of all greenhouse gas emissions in (MY01).

Current environmental regulations permit trucks to pollute more than cars. As a result, the average MY01 truck emitted 2.4 times more smog-forming pollution and 1.4 times more global warming gases than the average car. Those companies whose sales are dominated by trucks are generally dirtier; however, there are notable exceptions. Both Nissan and Ford are ranked above GM in our analysis—despite the fact that they sell more trucks than cars—because their trucks have lower smog-forming emissions.

The new vehicle fleet is getting cleaner in terms of key air pollutants. From MY00 to MY01, the average new vehicle sold by the Big Six released 24 percent fewer smog-forming emissions from the tailpipe, which accompanied the full implementation of new national tailpipe standards. Emissions reductions would have been even greater if the trend toward large trucks had not continued. Sales of the largest, dirtiest SUVs and pickups increased by over 30 percent in just one year.

Despite progress in reducing smog-forming emissions, the auto industry continued its trend toward higher emissions of global warming gases. As a result, the average heat-trapping gas emissions from a new MY01 vehicle were higher than they have been in over two decades.

Individual Automaker Results

Our analysis demonstrates that the pollution performance of automakers is neither uniform nor static. Large disparities exist among the six leaders in the US car market, and those differences change over time.

1. **Honda** continues to be the cleanest company by a significant margin. In 2001 its vehicles had 31 percent less smog-forming emissions than the average and 21 percent less heat-trapping gas emissions. But Honda's edge over the competition is slipping. In 1998, its commitment to sell large numbers of low-emission vehicles was noteworthy; by 2001, it became the industry standard due to new regulations.

Honda continues to be a leader on fuel economy. Its subcompact, compact, and midsize cars are among the most efficient in the industry. And, among the most popular vehicle models where Honda competes, it consistently offers some of the most fuel-efficient vehicles. The average Honda Civic, for example, is 7-12 mpg more efficient than every other best-selling compact car from the competition except the Toyota Corolla (which is only 1 mpg less efficient). The Civic is also the best-selling vehicle in its class. Honda's fleet average global warming gas emis-

sions, however, continued to increase for the sixth year in a row as the company added more trucks to its lineup and its average SUV and minivan became less fuel-efficient. For example, Honda's SUV fuel economy dropped over 5 percent from MY00 to MY01.

2. Toyota is firmly in second place overall. In 2001, its vehicles were 20 percent cleaner than the average for smog-forming emissions and 10 percent lower in greenhouse gas emissions. Toyota was the only company whose greenhouse gas emissions dropped from MY00 to MY01. This is particularly noteworthy given that it continued to shift its sales toward trucks and, in particular, the largest, least-efficient trucks. While the shift to large trucks has not yet posed a major global warming gas liability, it has caused Toyota's smog-forming emissions to fall behind third-place Nissan's since the biggest trucks face more lax tailpipe standards.

Toyota's cars are consistently more efficient than the competition in most size classes, and the Camry has the highest fuel economy of any popular mid-size car. Toyota's smaller trucks (e.g., the RAV4 SUV) are more efficient than the competition, but their large trucks (e.g., the 4Runner SUV or Tundra pickup) are not.

3. Nissan regained third place in MY01, after falling into fourth place behind Ford in MY00, as it was forced to meet new tailpipe standards for smog-forming pollutants. In MY01, Nissan's vehicles released 23 percent less smog-forming emissions but no less greenhouse gas emissions than the average. Particularly troubling is the fact that its average greenhouse gas emissions have been climbing rapidly in recent years. Nissan's cars and trucks are less efficient on average than they were three years ago, and Nissan has shifted to trucks faster than any other company. Aside from the Frontier compact pickup (which is the class leader among popular models), Nissan's best-selling vehicles are consistently among the laggards in most size classes.

4. Ford is the only automaker to have moved in our rankings over the last three years, displacing GM to take fourth place in MY01. Its commitment to voluntarily offer trucks with lower smog-forming emissions has boosted its rankings above GM's, despite the fact that its vehicles still emit 5 percent more greenhouse gas emissions. In MY00, Ford's clean truck commitment had earned it third place in our rankings, but new tailpipe standards forced Nissan to clean up its trucks in MY01 and overtake Ford. Although the new smog-forming emissions standards only apply to small and medium size trucks, Ford is also meeting a cleaner standard in its larger vehicles (e.g., the Expedition and F150). As a result, its big trucks are 16-18 percent cleaner than the average for their size class. With the largest trucks emitting 4-5 times the average car, Ford's clean-air commitment goes a long way to improving its environmental performance for smog-forming pollution. Of course, Ford's lower-emitting trucks are still several times dirtier than its cars. Indeed, if all of its trucks were as clean as cars, Ford would capture second place in our rankings.

In contrast, Ford's global warming gas performance is lackluster. Both their cars and their trucks are less fuel efficient than the average. In many size classes, Ford offers the least-efficient popular models. For example, its four-wheel drive large SUV, the Expedition, is 1.8 mpg less

efficient than the Chevy Tahoe; its Ford Taurus full-size car is 2.7 mpg less efficient than the Toyota Avalon.

More than its commitment to offer cleaner trucks with lower smog-forming tailpipe emissions, Ford has received considerable praise for its commitment to boost SUV fuel economy by 25 percent from MY00 to MY05. Our analysis confirms that Ford is on track toward meeting its goal, as SUV fuel economy improved 4.8 percent from MY00 to MY01. All of this improvement appears to stem from the introduction of smaller, more efficient SUVs like the Escape, as the average Explorer and Expedition was less efficient in MY01 than the year before. More importantly, most of Ford's SUV gains were offset by losses in the pickup market. The fuel economy of the average pickup dropped by 3 percent which, combined with climbing pickup sales, held Ford's overall truck fuel economy improvement to just 0.8 percent.

5. General Motors lost ground to Ford in our rankings because it did not keep up in offering trucks with lower smog-forming emissions, particularly as it moved more aggressively into the dirtiest, largest-truck market. Our analysis indicates that, had they matched Ford's clean air commitments for trucks, GM would have stayed in fourth place. On average, GM's vehicles have 14 percent higher emissions of smog-forming emissions, but they set the industry average for heat-trapping gas emissions.

GM's best-selling large SUVs and pickups are the class leaders among popular models, beating the competition by 1-2 mpg. Nonetheless, GM appears to have fallen behind Ford on average truck fuel economy in MY01. When Ford made its commitment to boost SUV fuel economy by 25 percent, GM vowed to retain its lead in overall truck fuel economy. While it may regain its lead by MY05, it now appears to be behind by 0.1 mpg. In making this assertion, we have excluded added fuel economy credits that both Ford and GM enjoy under a loophole in current CAFE regulations that permit "flex-fuel" vehicles designed to run on ethanol (but which almost never do) to receive inflated fuel economy ratings. Even with the added credits, however, GM only matches Ford on truck fuel economy.

6. DaimlerChrysler continues to be in last place, with vehicles 10 percent dirtier than the average for smog-forming emissions and 9 percent dirtier for greenhouse gases. In both the car and truck categories, DaimlerChrysler's vehicles are typically higher emitting, but their heavy focus on truck sales is what solidifies its position. Along with GM and Ford, DC is a major player in the larger truck market, and their smog-forming emission levels in these categories are among the dirtiest in the industry.

From MY00 to MY01, DC's fuel economy slipped more than any other automaker, despite the fact that it was the only company to shift sales back from trucks to cars. Interestingly, its SUV fuel economy improved as much as Ford's from MY00 to MY01, but all of these gains were offset by losses in pickup truck and minivan fuel economy, leading to an overall 2 percent drop in truck fuel economy. DC is the most aggressive in its use of the flex-fuel loophole to meet its fuel economy requirements. In MY01, it sold nearly 200,000 Dodge Caravans that exploit the loophole to give their trucks a boost of 0.7 mpg, the maximum amount allowed under current law.

Opportunities for Improvement

Many technologies exist to provide cost-effective reductions in both smog-forming and global warming gas emissions. New catalysts and better engine controls are allowing automakers to introduce new models with very low tailpipe emissions of nitrogen oxides and hydrocarbons ahead of regulatory deadlines. Costs for these improvements are modest for the manufacturer and minimal when compared with the public health benefits. In the immediate term, all trucks should be built to today's car tailpipe standards. In short order, all vehicles, regardless of size, should be able to meet even tighter standards that will be phased in from MY04-MY09. The companies that meet the standards early will come out on top of our green rankings.

Although emissions of global warming gases from motor vehicles have been steadily climbing for over 10 years, off-the-shelf technologies exist that could reduce global warming pollution while saving consumers at the pump. Recent studies by the National Academy of Sciences, the Union of Concerned Scientists, and the American Council for an Energy-Efficient Economy, confirm that cost-effective improvements are available right away (NRC 2002; Friedman et al 2001).

Automaker Actions. Our rankings clearly reflect the environmental progress that is attainable when companies make commitments to improve the pollution performance of their vehicles. Continued leadership by companies like Honda and Ford in introducing vehicles with lower tailpipe emissions is vital if they aim to stay ahead of the competition. All automakers need to work toward reducing their greenhouse gas emissions, as they have made little progress on this front. Ford's commitment to boosting the fuel economy of its SUVs, while attention getting, will mean little if these gains are swamped by losses elsewhere in their fleet, as appears to be the case in 2001.

Companies that seek improvements in smog-forming and greenhouse gas emissions will climb the green rankings. If Ford had reached farther with its commitment to build cleaner trucks and matched smog-forming emissions for their cars, it would have achieved second place in our ranking. If it had further extended its commitment to boost SUV fuel economy by 25 percent to all their trucks, it would be tied for first place with Honda. The reality is that an automaker's truck sales need not be an environmental liability.

Although there are many factors that determine an automaker's financial health, environmental stewardship can improve profitability. Reductions in smog-forming emissions are cheap, and cuts in global warming gases can come at a savings to consumers through lower gasoline bills. Public perception of corporate responsibility is an increasingly important issue for shareholders. Moreover, the automakers with the best environmental performance in our rankings have also been the most profitable on average. Honda, Toyota, and Nissan, for example, consistently post profits in excess of $1,000 per vehicle (Harbour Report 2002). When Ford was making its most significant investments in cleaner truck technology in the late 1990s, its profits were at record highs.

Policymaker Actions. Voluntary clean-up actions on the part of automakers are a welcome change. But if past is prologue, the auto industry as a whole will not embrace meaningful environmental initiatives without government intervention. All of the emissions reductions touted by industry in efforts to highlight how clean cars have become were a direct result of clean air regulations. Government has recently passed new laws that will eliminate gaping loopholes in smog-forming emissions rules, eventually requiring all trucks and cars to meet the same standard by decade's end.

No progress has been made in reducing either the global warming gas emissions or oil consumption of motor vehicles. Loopholes persist such as the flex-fuel vehicle credit or more lax standards for SUVs and other trucks, that are leading to greater environmental damage. In the face of growing evidence that global warming will have severe economic and environmental consequences,
as well as the constant reminders of the risks associated with oil dependence, policymakers cannot continue to ignore the many technologies available to reduce heat-trapping emissions or fuel use.

Unfortunately, automakers continue to fight policies that require improvements in the environmental and safety performance of their products, despite years of evidence proving that such changes are low-cost and high-return for health and safety. Policymakers need to tap the engineering prowess of the industry by giving automakers a much-needed push toward environmental stewardship.

Appendix A: Methodology

Automakers Evaluated

To develop our ranking, we focused on emissions from the six automakers with the largest market share: General Motors (27 percent), Ford (23 percent), DaimlerChrysler (18 percent), Toyota (11 percent), Honda (7 percent), and Nissan (5 percent). Our analysis indicates that the Big Six account for 93 percent of all smog-forming emissions and 92 percent of all greenhouse gas emissions from new vehicles.[16]

We have analyzed only the portion of each automaker's sales defined as light-duty passenger vehicles under federal law; i.e., those vehicles under 8,500 pounds gross vehicle weight.[17] Some automakers sell vehicles for passenger use that fall outside of this official designation, including several large pickup trucks, the Ford Excursion, and several versions of the Chevrolet Suburban. In the future, some of these vehicles will be captured as passenger vehicles under emission regulations, but there are currently no regulations that would require them to be tested for fuel economy. While we believe these large passenger SUVs and pickups should be counted as part of an automakers' pollution performance, the data that would enable us to include them in such an analysis are not currently available.[18]

Pollutants Evaluated

To understand the impact that each automaker's sales have on the environment, we focused on two key problems—air pollution and global warming. The impact of passenger vehicles goes far beyond these two environmental concerns to include water pollution, land use issues, congestion, and other social problems. However, our focus is limited to issues where passenger vehicles have a significant impact on public health and the environment.

Air Pollution. In our analysis we focus on two key air pollutants—nitrogen oxides (NOx) and non-methane organic gases (NMOG)[19]—that are the leading cause of urban ozone, or smog. Urban ozone continues to be one of the most significant health threats associated with air pollution. More Americans live in areas that are not in compliance with federal air quality guidelines for ozone levels than for any other pollutant. In focusing on NOx and NMOG, we neglect other key air pollutants associated with motor vehicles, namely carbon monoxide (CO), particulate matter (PM), and toxics (e.g., benzene). These other pollutants are certainly public health hazards, although CO emissions from new vehicles have declined substantially due to three decades of

[16] Estimating greenhouse gas emissions for the remaining 13 companies is relatively straightforward, since fuel economy data is readily available. To estimate smog-forming emissions from the remainder of the fleet, we assume that the remaining 13 companies' cars and trucks have the same average emissions as those of the Big Six. With data on the car vs. truck split for the remaining 13, we then develop fleet-aggregate emissions factors.

[17] Gross vehicle weight is the vehicle's curb weight plus maximum cargo capacity.

[18] The Big Three are the dominant players in this segment of the truck market. Thus, including such vehicles would only drop their overall environmental ranking.

[19] NMOG is a category of hydrocarbon emissions that reactive to form ozone. They are similar, but not identical, to other classes of hydrocarbons often measured for air quality purposes, including non-methane hydrocarbons (NMHC) and volative organic compounds (VOC).

regulations. PM and toxic emissions from gasoline vehicles are not measured directly during emissions tests, making accurate estimates for these two pollutants more difficult—particularly when differentiating emissions rates between vehicles in a ranking such as ours.

Our analysis also evaluates only pollution emitted from a vehicle's tailpipe, ignoring three other emissions sources associated with vehicles and vehicle use: vehicle manufacture, upstream emissions from fuel production and delivery, and evaporative emissions from the vehicle itself.[20] These emissions sources are important—particularly for the communities in which they are released—but are unlikely to change our overall ranking:

- Emissions data from vehicle manufacture and disposal are neither universally nor uniformly reported (Keoleian et al 1997). However, one estimate suggests that about 89 percent of the air pollution, weighted by health damage, occurs during vehicle usage (DeCicco and Thomas 1999). Thus, emissions from manufacture and disposal are small relative to tailpipe emissions.

- Upstream emissions associated with the extraction, refining, and delivery of gasoline are typically considered to be proportional to fuel use. Thus, their inclusion would be equivalent to placing greater weight on fleet average fuel economy but would likely not change our overall ranking. As tailpipe standards become increasing stringent over time, however, upstream emissions may become a more important determinant of a vehicle's pollution impact.

- Evaporative emission standards are the same for cars and light trucks, regardless of size, so including them would not have greatly impacted our relative ranking.

Global Warming Emissions. Although carbon dioxide is the most important heat-trapping gas emitted by motor vehicles, vehicle use is also associated with other pollutants that cause global warming, including methane, nitrous oxides, and refrigerants. Our analysis measures CO_2 emissions from the vehicle itself (the largest source of greenhouse gas emissions) as well as three heat-trapping gases associated with the production and delivery of fuel—CO_2, methane, and nitrous oxides. We ignore two other sources of greenhouse gases in our calculations—vehicle manufacture and non-CO_2 tailpipe emissions.

- Roughly 10 percent of the energy use—and essentially the same share of global warming emissions—occurs during manufacturing and disposal of vehicles (Delucchi 1991), making fuel production and vehicle operation far more important sources.

- Vehicular emissions of non-CO_2 heat-trapping gases are not well measured, and potential differences between vehicles (based on technology, size, manufacturer, operation, etc.) are poorly understood. Preliminary estimates suggest that 95 percent of the global warming impact of a vehicle's heat-trapping gas emissions result from CO_2.[21]

[20] Vehicles emit hydrocarbons through the engine and refueling system as the fuel evaporates, even when the vehicle is not in operation.

[21] UCS estimate based on EIA (2000).

Data Sources

Our emissions estimates for new vehicles rely on several government databases, which we combined to develop an overall picture of the pollution status of individual companies. Due to reporting limitations and proprietary concerns, there is considerable lag time between the end of the model year and the release of the information to the public. For our analysis, the most recent data available were for MY01. Based on past experience, these data will be updated and refined over time, but we felt that there was sufficient coverage of MY01 to develop an accurate picture of automakers' emissions performance.

Smog-Forming Emissions. The smog-forming emission calculations rely on two databases held by the Environmental Protection Agency. The first database assigns sales numbers by model year to individual engine families.[22] An engine family is a group of engines designed with the same primary characteristics that are used for EPA emissions certification. A given engine family may be used in several vehicles. For example, in MY01 over 250,000 of one Ford engine family were installed in the Explorer, Explorer Sport, Explorer Sport Trac, Ranger, Mazda B4000, and Mercury Mountaineer.

The second database we worked with assigns emissions standards to each engine family.[23] In some, limited cases, one engine family will be assigned two emissions standards. This is typically a result of two conditions: (a) that engines from the family are installed in two different vehicles that are held to two different emissions standards due to different weights, or (b) that some of the engines in the family are certified to a lower emissions standard in California. We made post-hoc adjustments to address both of these issues by splitting engine sales equally among different emissions levels.[24]

In comparing automakers, we assumed that the 100,000-mile emissions certification standards offer an adequate picture of the relative performance of the companies' engines. It is widely recognized that, under real-world driving conditions and over the life of a vehicle, engines typically emit more than the standard (Ross et al 1995). In reality, it is not clear whether this gap is constant for all types of vehicles and manufacturers. For example, by relying solely on the certification standards, we do not account for the possibility that one automaker's vehicles may perform worse than another's in actual use. Nonetheless, we believe that vehicles meeting a tighter emission standard should be cleaner in relative terms; i.e., that a LEV vehicle will be cleaner than a Tier 1 vehicle. We do not, however, assume that the certification levels represent emissions levels in the real world.

Global Warming Gases. Emissions estimates for heat-trapping gases rely on both a database held by the National Highway Traffic Safety Administration (NHTSA)[25] and a model created by Argonne National Laboratory (ANL). The NHTSA database reports vehicle production numbers and official CAFE test values by vehicle type. The CAFE test values are the combined result of measured fuel economy over the city

[22] UCS received the sales data from EPA upon request.

[23] Data available online from EPA's Green Vehicle Guide (www.epa.gov/otaq). In some cases, we found engine families that were associated with sales numbers but were not included in the Green Vehicle Guide's database. In those instances, we used the Certification and Fuel Economy Information System (CFEIS) database to determine relevant certification values.

[24] In the case where an engine family meets one standard in California and another federally, assigning half of the sales to the lower California standard may underestimate total emissions for the family. However, since several states comprising more than one-fourth of the new car market have adopted the California Low Emission Vehicle program, and since there is likely a spillover effect from these states to the surrounding car markets, we feel that our assumption is appropriate.

[25] UCS received the NHTSA data upon request.

MY01 Flex-Fuel Vehicle Sales and Impact on CAFE Average

	Cars			Trucks			Both		
	FFV Sales	CAFE w/ credits	CAFE w/o credits	FFV Sales	CAFE w/ credits	CAFE w/o credits	FFV Sales	CAFE w/ credits	CAFE w/o credits
DC	-	27.2	27.2	198,200	20.7	20.0	198,200	22.5	21.9
FORD	66,000	27.3	26.8	42,200	20.5	20.3	108,200	23.0	22.7
GM	-	27.9	27.9	91,600	20.5	20.2	91,600	24.0	23.8
HONDA	-	31.9	31.9	-	24.9	24.9	-	30.1	30.1
NISSAN	-	28.1	28.1	-	20.7	20.7	-	23.9	23.9
TOYOTA	-	30.4	30.4	-	22.1	22.1	-	26.4	26.4
ALL	66,000	28.5	28.4	332,000	20.8	20.5	398,000	24.1	23.8

and the highway driving cycles, assuming 55 percent of the driving occurs over the city cycle. The resulting mile per gallon (mpg) figures are not the values reported on the window sticker of new cars or in other government databases (e.g., www.fueleconomy.gov), which attempt to adjust for differences between fuel economy performance in the real world and in government laboratory tests. Thus, we do not assume that the mpg values accurately reflect real-world performance but rather, as with smog-forming emissions standards, they are an accurate depiction of automakers' relative fuel economy.

In determining fuel economy values from the NHTSA database, we make one important correction for the sale of so-called flexible fuel vehicles (FFVs) that can run on gasoline and/or ethanol fuel. Under the Alternative Motor Fuel Act, such FFVs receive inflated CAFE mpg values in the expectation that a portion of their travel will be on non-petroleum fuels and, therefore, the miles that they travel for each gallon of gasoline will be higher. In reality, these vehicles rarely run on alternative fuels (DOT 2002). Thus, we discount the inflated mpg values for the nearly 400,000 FFVs sold in MY01.[26] The impact of removing the inflated FFV credits is to lower the CAFE values for the automakers that use them—by 0.6 mpg for DaimlerChrysler, 0.3 mpg for Ford, and 0.2 mpg for General Motors.

We calculate heat-trapping emissions by applying a uniform emissions rate to each gallon of gasoline consumed, equal to 11.1 kg CO_2-equivalent emissions per gallon of gasoline. This value includes greenhouse gas emissions associated with gasoline production and delivery (so-called upstream emissions) as well as the CO_2 released when the fuel is burned in the engine. The estimate is for federal reformulated gasoline and is based on the latest available version of a model developed by Argonne National Laboratory, GREET 1.6ß.[27] GREET accounts

[26] To do this, we assume that a FFV has the same efficiency when running on ethanol as when running on gasoline and therefore has the same fuel economy as a gasoline-only version on an equivalent energy basis. Using the formula used to calculate the FFV credits and the relative lower heating values of reformulated gasoline and ethanol, we divide the reported FFV mpg value by 1.63.

[27] The model is available for download at www.anl.gov. For model details, see Wang (1999).

for several heat-trapping gases—including methane, nitrous oxide, and carbon dioxide—expressing the results as CO_2-equivalent emissions based on their relative radiative forcing.

Ranking

Based on databases of air emissions and fuel economy, we develop sales-weighted emissions rates for smog-forming and greenhouse gas emissions by manufacturer. The resulting grams-per-mile values represent the emissions from each automaker's average vehicle. We emphasize that the average emissions rates are not meant to represent real-world emissions, since the certification values used for smog-forming emissions and fuel economy do not represent in-use performance. Nonetheless, these estimates allow relative comparisons among companies.

In developing the smog-forming emissions ranking, we simply add emissions of NOx and NMOG, which has become somewhat of a convention among air regulators.[28] Other, more comprehensive analyses have used estimates of the public health and environmental damage of several pollutants to weigh their impact in a combined "environmental damage" score (DeCicco and Thomas 1999). We use the NOx+NMOG convention for simplicity and transparency, but we also tested the impact of using the more comprehensive, damage-based approach applied to NOx, NMOG, CO, and PM for the emission certification values in our database. The rankings by automaker were unchanged.

To develop an overall ranking, we combine the smog-forming and global warming emissions rankings, giving equal weighting to each. Whereas in our original analysis of MY98 vehicles we developed standardized values using a bell curve for each emissions class and then averaged the results, in this analysis we simply normalize emissions by taking the ratio of each manufacturer's emissions to the average for the Big Six. For example, Ford's greenhouse gas emissions are 5 percent higher than the average, but their smog-forming emissions are 1 percent lower; their combined score is then 2 percent over the average.[29] Similarly, GM's heat-trapping gas emissions are equal to the average, but their smog-forming emissions are 14 percent higher; their combined score is 7 percent over the average. Where we compare results from MY01 to our original analysis for MY98, we use the same method of combining results to ensure consistency.

[28] For example, EPA's Green Vehicle Guide uses NOx+NMOG as its primary determinant of a vehicle's pollution level.

[29] Mathematically, this is calculated as the average of 5% (=1.05) and –1% (=0.99): (1.05+0.99)/2 = 1.02.

Appendix: Detailed Data Tables

MY01 Flex-Fuel Vehicle Sales and Impact on CAFE Average

	Smog Forming Emissions			Greenhouse Gas Emissions			Combined		
	MY98	MY00	MY01	MY98	MY00	MY01	MY98	MY00	MY01
DC	13%	18%	10%	9%	7%	9%	11%	13%	9%
FORD	7%	-10%	-1%	6%	4%	5%	7%	-3%	2%
GM	2%	15%	14%	-1%	0%	0%	1%	8%	7%
HONDA	-41%	-46%	-31%	-22%	-21%	-21%	-32%	-34%	-26%
NISSAN	-14%	-4%	-23%	-10%	0%	0%	-12%	-2%	-12%
TOYOTA	-15%	-15%	-20%	-12%	-9%	-10%	-13%	-12%	-15%

MY00 and MY01 Estimated Emissions Rates (g/mi)

	MY00 NOx+NMOG	MY01 NOx+NMOG	MY00 GHG	MY01 GHG
Cars				
DC	0.68	0.39	413	408
FORD	0.60	0.42	411	414
GM	0.74	0.39	403	397
HONDA	0.41	0.38	352	348
NISSAN	0.64	0.38	395	395
TOYOTA	0.54	0.38	370	365
Big Six	0.63	0.39	395	391
Trucks				
DC	1.22	0.96	544	556
FORD	0.97	0.84	551	547
GM	1.33	1.21	539	551
HONDA	0.69	0.67	438	445
NISSAN	1.09	0.61	526	537
TOYOTA	1.07	0.77	510	503
Big Six	1.15	0.93	538	542
Both				
DC	1.03	0.73	497	506
FORD	0.79	0.66	481	489
GM	1.00	0.76	465	466
HONDA	0.47	0.45	366	369
NISSAN	0.84	0.51	463	465
TOYOTA	0.74	0.53	422	420
Big Six	0.87	0.66	463	466

MY01 and MY00 EPA Sales Data, by Size Class

	Cars	Large Trucks	Largest Trucks	Medium Trucks	Small Trucks	Total
MY01						
DC	1,131,831	420,468	149,975	1,023,592	41,827	2,767,693
FORD	1,546,629	290,150	426,206	933,772	323,472	3,520,229
GM	2,287,461	563,245	521,910	597,466	188,365	4,158,447
HONDA	836,719	-	-	164,603	117,003	1,118,325
NISSAN	326,332	-	-	384,139	40,845	751,316
TOYOTA	986,388	73,532	73,148	356,748	148,799	1,638,615
Big Six	7,115,360	1,347,395	1,171,239	3,460,320	860,311	13,954,625
DC	41%	15%	5%	37%	2%	100%
FORD	44%	8%	12%	27%	9%	100%
GM	55%	14%	13%	14%	5%	100%
HONDA	75%	0%	0%	15%	10%	100%
NISSAN	43%	0%	0%	51%	5%	100%
TOYOTA	60%	4%	4%	22%	9%	100%
Big Six	51%	10%	8%	25%	6%	100%
MY00						
DC	956,538	362,854	75,089	1,233,888	47,499	2,675,868
FORD	1,929,043	192,678	446,091	1,101,942	170,926	3,840,680
GM	2,568,088	763,953	337,793	764,901	217,556	4,652,291
HONDA	906,949	-	-	122,131	114,387	1,143,467
NISSAN	449,171	-	-	296,632	59,235	805,038
TOYOTA	1,044,277	114,899	36,632	332,944	128,392	1,657,144
Big Six	7,854,066	1,434,384	895,605	3,852,438	737,995	14,774,488
DC	36%	14%	3%	46%	2%	100%
FORD	50%	5%	12%	29%	4%	100%
GM	55%	16%	7%	16%	5%	100%
HONDA	79%	0%	0%	11%	10%	100%
NISSAN	56%	0%	0%	37%	7%	100%
TOYOTA	63%	7%	2%	20%	8%	100%
Big Six	53%	10%	6%	26%	5%	100%

MY01 Emissions, by Size Class (g/mi)

	All Cars	Large Truck	Largest Truck	Medium Truck	Small Truck	All Trucks	All Vehicles
DC	0.39	1.36	2.05	0.65	0.54	0.96	0.73
FORD	0.42	1.08	1.49	0.62	0.44	0.84	0.66
GM	0.39	1.37	1.97	0.63	0.42	1.21	0.76
HONDA	0.38	-	-	0.62	0.76	0.67	0.45
NISSAN	0.38	-	-	0.63	0.39	0.61	0.51
TOYOTA	0.38	1.39	1.56	0.63	0.39	0.77	0.53
Big Six	0.39	1.31	1.78	0.63	0.47	0.93	0.66

MY01 Fuel Economy, by Size Class (mpg)

	Cars					Trucks			Total
	Sub-compact	Compact	Mid-Size	Full-Size	All Cars	Sm/Med Truck	Large Truck	All Trucks	All Vehicles
DC	26.7	29.4	26.6	25.3	27.2	21.6	17.3	20.0	21.9
FORD	26.6	31.5	25.4	24.5	26.8	22.2	18.6	20.3	22.7
GM	31.1	29.9	27.0	26.1	27.9	23.5	18.5	20.2	23.8
HONDA	32.7	39.5	28.4	-	31.9	24.9	-	24.9	30.1
NISSAN	-	29.8	25.7	-	28.1	20.7	-	20.7	23.9
TOYOTA	28.2	36.3	27.9	26.7	30.4	23.9	18.1	22.1	26.4
Big Six	28.3	32.0	27.1	25.3	28.4	22.4	18.3	20.5	23.8

MY01 Flex-Fuel Vehicle Sales and Impact on CAFE Average

	Cars			Trucks			Both		
	FFV Sales	CAFE w/ Credits	CAFE w/o Credits	FFV Sales	CAFE w/ Credits	CAFE w/o Credits	FFV Sales	CAFE w/ Credits	CAFE w/o Credits
DC	-	27.2	27.2	198,200	20.7	20.0	198,200	22.5	21.9
FORD	66,000	27.3	26.8	42,200	20.5	20.3	108,200	23.0	22.7
GM	-	27.9	27.9	91,600	20.5	20.2	91,600	24.0	23.8
HONDA	-	31.9	31.9	-	24.9	24.9	-	30.1	30.1
NISSAN	-	28.1	28.1	-	20.7	20.7	-	23.9	23.9
TOYOTA	-	30.4	30.4	-	22.1	22.1	-	26.4	26.4
Big Six	66,000	28.5	28.4	332,000	20.8	20.5	398,000	24.1	23.8

MY01 NHTSA Truck Sales and Fuel Economy, by Vehicle Type

	Pickups	Vans	SUVs	All Trucks
Sales				
DC	518,300	433,700	829,700	1,781,700
Ford	937,800	274,200	785,300	,997,300
GM	763,600	289,800	797,600	1,851,000
Honda	-	108,100	144,300	252,400
Nissan	109,400	32,400	235,500	377,300
Toyota	251,900	86,000	309,500	647,400
Big Six	2,581,000	1,224,200	,101,900	6,907,100
Sales Breakdown				
DC	29%	24%	47%	100%
Ford	47%	14%	39%	100%
GM	41%	16%	43%	100%
Honda	0%	43%	57%	100%
Nissan	29%	9%	62%	100%
Toyota	39%	13%	48%	100%
Big Six	37%	18%	45%	100%
Fuel Economy (mpg)				
DC	17.5	23.1	20.3	20.0
Ford	20.0	22.5	20.0	20.3
GM	20.2	22.7	19.3	20.2
Honda		23.9	25.7	24.9
Nissan	22.3	22.6	19.8	20.7
Toyota	21.2	24.7	22.2	22.1
Big Six	19.4	23.6	20.3	20.5
Fuel Economy vs. MY00				
DC	-4.9%	-1.3%	4.9%	-2.1%
Ford	-3.0%	3.2%	4.9%	0.8%
GM	-0.6%	2.2%	-3.7%	-2.1%
Honda		-0.4%	-5.3%	-1.6%
Nissan	1.3%	-0.4%	0.3%	-1.9%
Toyota	2.4%	2.1%	1.5%	1.4%
Big Six	-2.2%	0.5%	2.3%	-0.7%

MY01 Fuel Economy of the Most Popular Trucks, by Model

	Average		2WD		4WD		
	Sales ('000)	mpg	Sales ('000)	mpg	Sales ('000)	mpg	% 4WD
Small SUV							
DC (Jeep Cherokee)	119	20.2	25	20.8	93	20.0	79%
Ford (Escape)	151	23.8	65	24.5	86	23.4	57%
GM (Chevy Tracker)	57	25.2	14	25.9	43	25.0	76%
Honda (CR-V)	105	27.2	16	27.5	89	27.1	85%
Nissan (n/a)							
Toyota (RAV4)	87	29.2	41	30.3	46	28.3	53%
Mid-Size SUV							
DC (Grand Cherokee)	149	20.3	56	20.8	93	20.0	63%
Ford (Explorer)	274	19.9	96	20.4	178	19.7	65%
GM (Chevy Blazer)	166	21.5	53	22.2	113	21.2	68%
Honda (Passport)	24	21.3	11	21.7	13	21.0	53%
Nissan (Xterra)	96	20.0	48	20.4	47	19.7	50%
Toyota (4Runner)	87	21.1	37	21.9	50	20.5	58%
Large SUV							
DC (n/a)							
Ford (Expedition)	175	17.4	98	18.5	77	16.2	44%
GM (1500 Tahoe)	195	17.9	79	17.8	116	18.0	60%
Honda (n/a)	-	-	-	-	-	-	-
Nissan (n/a)	-	-	-	-	-	-	-
Toyota (Sequoia)	55	17.6	22	17.9	34	17.4	61%
Compact Pickup							
DC (Dodge Dakota)	159	18.8	88	19.9	70	17.7	44%
Ford (Ranger)	268	21.9	184	23.2	84	19.6	31%
GM (Chevy S10)	96	21.8	52	22.4	44	21.1	46%
Honda (n/a)	-	-	-	-	-	-	-
Nissan (Frontier)	109	22.3	65	22.7	45	21.9	41%
Toyota (Tacoma)	159	22.9	90	24.0	69	21.7	44%
Large Pickup							
DC (Dodge Ram 1500)	360	16.9	202	17.8	157	16.0	44%
Ford (F150)	587	19.0	354	20.0	233	17.8	40%
GM (Chevy 1500 Silverado)	429	19.3	243	19.7	186	18.6	43%
Honda (n/a)	-	-	-	-	-	-	-
Nissan (n/a)	-	-	-	-	-	-	-
Toyota (Tundra)	93	18.8	53	19.3	40	18.0	43%
Minivan							
DC (Caravan/TC/Voyager)	400	23.7	384	23.8	16	22.3	4%
Ford (Windstar)	176	23.4	176	23.4	-	-	-
GM (Chevy Venture)	85	25.4	85	25.4	-	-	-
Honda (Odyssey)	108	23.9	108	23.9	-	-	-
Nissan (Quest)	32	22.6	32	22.6	-	-	-
Toyota (Sienna)	86	24.7	86	24.7	-	-	-

MY01 Fuel Economy of the Most Popular Cars, by Model

	Sales ('000)	MPG
Compact		
DC (Dodge Neon)	141	31.1
Ford (Focus)	233	32.8
GM (Chevy Cavalier)	220	30.5
Honda (Civic)	333	39.5
Nissan (Altima)	137	27.7
Toyota (Corolla)	226	38.5
Mid-Size		
DC (Dodge Stratus)	84	27.1
Ford (Mercury Sable)	92	25.7
GM (Chevy Malibu)	187	27.2
Honda (Accord)	429	29.1
Nissan (Maxima)	101	25.7
Toyota (Camry)	308	30.0
Full-Size		
DC (Dodge Intrepid)	113	26.3
Ford (Taurus)	333	25.1
GM (Chevy Impala)	188	27.1
Honda (n/a)		
Nissan (n/a)		
Toyota (Avalon)	79	27.8

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