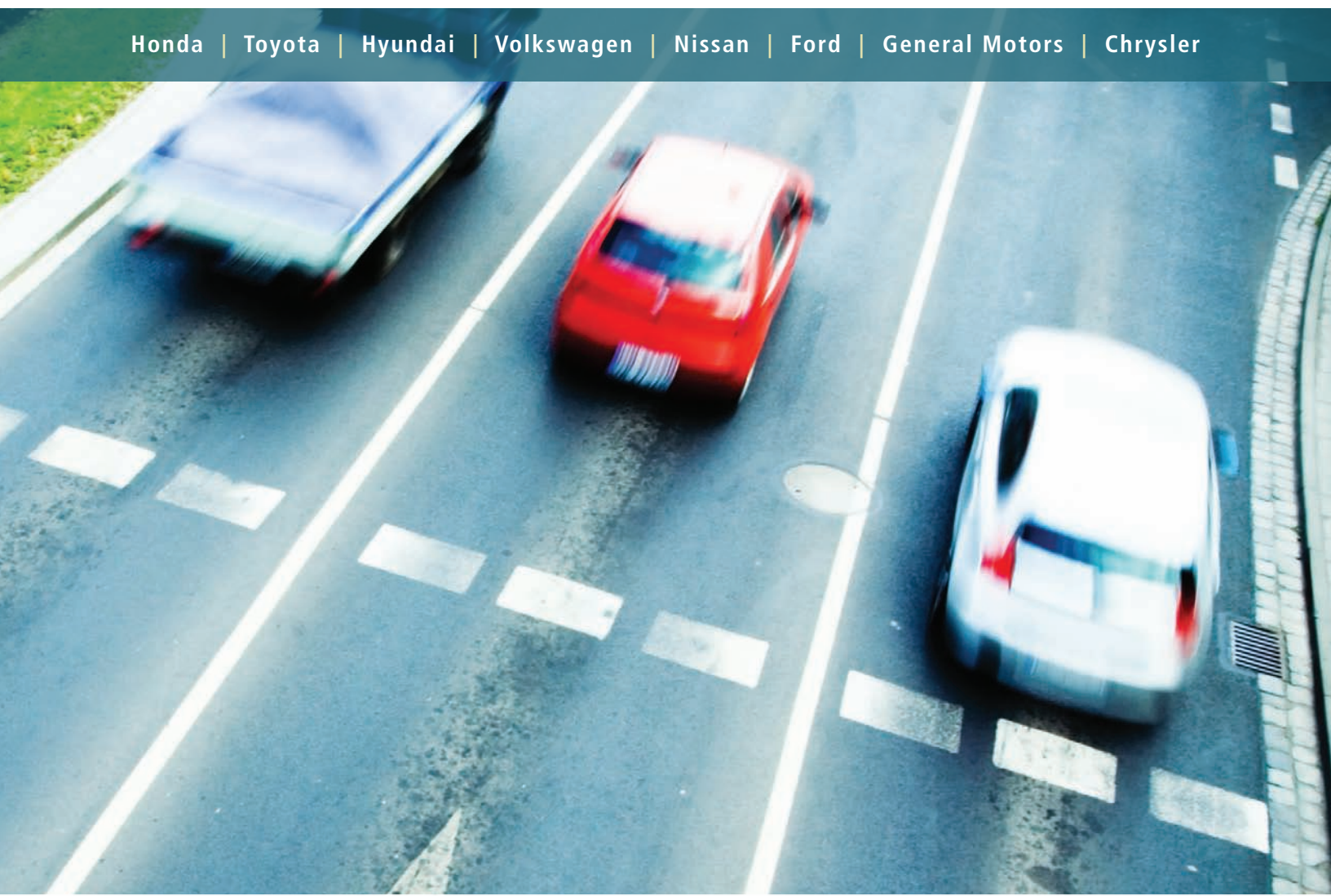


AUTOMAKER RANKINGS 2010

THE ENVIRONMENTAL
PERFORMANCE OF
CAR COMPANIES

Honda | Toyota | Hyundai | Volkswagen | Nissan | Ford | General Motors | Chrysler



Union of
Concerned
Scientists

Citizens and Scientists for Environmental Solutions

**AUTOMAKER
RANKINGS
2010**
**THE ENVIRONMENTAL
PERFORMANCE OF
CAR COMPANIES**

JIM KLIESCH

UNION OF CONCERNED SCIENTISTS
OCTOBER 2010

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Jim Kliesch is a senior engineer in the Union of Concerned Scientists Clean Vehicles Program.

The Union of Concerned Scientists (UCS) is the leading science-based nonprofit working for a healthy environment and a safer world.

The UCS Clean Vehicles Program develops and promotes strategies to reduce the adverse environmental impact of the U.S. transportation system.

More information about UCS and the Clean Vehicles Program is available on the UCS website at www.ucsusa.org.

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Automobiles, Automakers, and the Environment

Our nation is a major contributor to global warming and smog pollution, with its passenger vehicles playing a principal role. The transportation sector accounts for roughly one-third of U.S. carbon emissions, of which more than half (about 60 percent) come from the use of gasoline in our cars, pickups, SUVs, and minivans. Emissions of smog-forming pollutants also are sizable. As of 2007, passenger vehicles accounted for roughly one-sixth of the smog-forming gases—nitrogen oxides (NO_x) and volatile organic compounds (VOC)—emitted in the United States.

Both types of pollution are genuinely bad actors. Today more than 40 percent of the U.S. population lives in areas that exceed current federal health guidelines for smog,¹ resulting in a host of respiratory illnesses across the country. At the same time, global warming continues to be the most serious long-term environmental threat now facing the world.

While some headway is being made in reducing smog, the effort to clean up vehicle emissions continues to be an uphill fight. Some 250 million cars and light trucks are currently being driven on U.S. roads—more than twice the number of vehicles that were in use during the energy crises of the mid-1970s. In addition, Americans are driving their cars and trucks more than ever before, leading to higher global warming emissions and oil consumption.

These problems have not been lost on the American consumer. In recent years, especially the past decade, people have become increasingly concerned about the environmental impacts of the vehicles they drive; and in response to the new demand, manufacturers are increasingly touting “green” automotive technologies and



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product lines and making claims of ecological stewardship. Yet upon closer scrutiny, many of their assertions lack substance.

This report puts companies’ green-marketing statements to the test by using government data to measure the environmental performance of each of the eight best-selling (“Top Eight”) automakers’ product offerings. Focusing on model year 2008 (MY2008)—the latest year for which final data are available—and assessing each manufacturer based on the sales-weighted² smog-forming and global warming emissions of its vehicle fleet, we objectively measure the companies’ true environmental performance.

In addition to gauging manufacturers’ overall performance, this study also assesses their performance within a range of vehicle classes. And it evaluates the effectiveness of specific automotive technologies currently being marketed for their green merits. Finally, we offer suggestions as to how each manufacturer can make authentic environmental improvements in its fleet.

1 Data for eight-hour ozone nonattainment areas, as of June 15, 2010, from the Environmental Protection Agency’s Green Book (<http://www.epa.gov/oar/oaqps/greenbk/gntc.html>).

2 Sales-weighted results are based on an automaker’s proportion of vehicles sold. Thus while a model sold in very small numbers will have a limited effect on the manufacturer’s overall result, a model sold in high volume will have a relatively large impact.

Ranking Method

This report is the Union of Concerned Scientists' fifth evaluation of the environmental performance of the major automakers in the United States, a continuing project that we have been conducting for 10 years. As in the preceding reports (MacKenzie 2007; Friedman and MacKenzie 2004; Mark 2002; Morey et al. 2000), the current study assesses the relative environmental performances of the leading automakers based on the most recent data available about their product lines. Selling a modest number of clean and efficient models is not sufficient to gain the designation of green automaker; the best scores go to those that show strong environmental performance across their product lines. Thus the rankings reflect the average emissions of global warming and smog-forming pollutants from the entire fleet of each automaker's offerings.

Average per-mile global warming emissions for each Top Eight automaker are calculated as a function of the fuel economy, fuel type, and sales of each vehicle type sold by the automaker in MY2008. The global warming emissions considered include both tailpipe emissions and upstream emissions from the production and distribution of fuel, which together account for more than 85 percent of a vehicle's lifetime global warming emissions (Burnham, Wang, and Moon 2006; Weiss et al. 2000). A sales-weighted average emissions level is calculated for each manufacturer, and an industry average of the eight manufacturers combined is computed as well.

The industry-average emissions rate is assigned a score of 100 so that an individual automaker's score reflects its emissions rate relative to the industry norm. Thus a manufacturer's score of 80 indicates an emissions level equal to 80 percent of the industry average or, put another way, 20 percent cleaner than the industry average. With a score of less than 100 indicating better-than-average performance and a score of more than 100 revealing worse-than-average performance, the lower an automaker's overall score, the more eco-friendly it is.

The calculation of an automaker's average smog-forming tailpipe emissions is based on the sum of its emissions certification levels for NO_x and non-methane organic gases (NMOG, a measure of VOC emissions), as well as on the sales of each type of vehicle sold by that manufacturer.³ The industry average is again assigned a score of 100, to which each automaker's individual results are indexed.

The overall ranking of each manufacturer is determined by averaging its global warming score with its smog score, thus creating a combined score that weights global warming emissions and smog-forming emissions equally at 50 percent. Additional details on the methodology are available online at www.ucsusa.org.

³ As nearly all vehicles today are certified to more than one emissions level (typically one federal and one state), they are evaluated in this study on their cleanest certification.

Ranking Results

Our rankings compare the leading automakers in the United States based on the average emissions of smog-forming and global warming pollutants from each company's MY2008 fleet. To better understand the origins of these values, we also assess the manufacturers' pollution performance within various vehicle classes, and we examine the eco-impacts of certain emerging technologies.

To develop these rankings, we focus on the eight automakers that together account for 92 percent of MY2008 vehicle sales in the United States: General Motors (GM, 22 percent), Ford (16 percent), Toyota (16 percent), Chrysler (12 percent), Honda (11 percent), Nissan (7 percent), Hyundai (5 percent), and Volkswagen (2 percent).⁴ Vehicles from these Top Eight automakers accounted for approximately 92 percent of heat-trapping emissions and 92 percent of smog-forming emissions from new light-duty vehicles in 2008.⁵

Overall Fleet Comparisons

This year, Honda just barely retains its title of greenest automaker. Honda has captured the top spot in all five of our automaker-ranking analyses (which assessed vehicle model years 1998, 2001, 2003, 2005, and 2008), though the company's victory this year was anything but overwhelming. Competition for the crown was closer than ever before, with a virtual three-way photo finish between Honda, Toyota, and Hyundai.

As shown in Table 1, Honda claims the title with an overall score of 86 points, indicating a fleet that is 14 percent better than the average of all eight manufacturers assessed, and almost 30 points better than the fleet of Chrysler—the manufacturer with the worst overall product ranking. The scores of Toyota and Hyundai are so close that we deem them to be tied for second place, only one point behind Honda. Volkswagen and Nissan fall just below the front-runner pack, while the Detroit Three (Ford, GM, and Chrysler) round out the bottom positions with pollution levels much higher than average. Chrysler wins the “dirty tailpipe” award for coming in last place, a repeat of its ranking last year

Table 1. MODEL YEAR 2008 OVERALL RESULTS

RANK	AUTOMAKER	SCORE
1	Honda	86
2	Toyota Hyundai	87
4	Volkswagen	90
5	Nissan	93
6	Ford	108
7	General Motors	109
8	Chrysler	113

and a dubious distinction it has earned in four of the five Union of Concerned Scientists (UCS) automaker-ranking assessments.

Figure 1 (p. 4) details each automaker's average global warming and smog scores. It illustrates not only how close the competition has been this year for top overall ranking but also how poor the Detroit Three fare relative to the other major manufacturers. Given the fleet average of 100, the Detroit automakers have poorer-than-average smog and global warming levels for its fleets, while all other automakers have better-than-average levels.

Toyota and Volkswagen tie for the lowest smog-forming pollutant emissions in this year's assessment, while Honda and Hyundai tie for the lowest global warming emissions. Honda's narrow overall victory comes from its edge over Hyundai on smog and because the margin that Honda maintained over Toyota on global warming was just large enough to offset its loss on smog.

⁴ Percentages do not add up to 100 because of rounding.

⁵ Each automaker produced vehicles under multiple division names. While portfolios change as companies are purchased and sold, the following reflects the brands considered in assessing MY2008 vehicles: *Chrysler* (Chrysler, Dodge, Jeep); *Ford* (Ford, Jaguar, Land Rover, Lincoln, Mazda, Mercury, Volvo); *GM* (Buick, Cadillac, Chevrolet, GMC, Hummer, Isuzu, Pontiac, Saab, Saturn); *Honda* (Honda, Acura); *Hyundai* (Hyundai, Kia); *Nissan* (Nissan, Infiniti); *Toyota* (Toyota, Lexus); *Volkswagen* (Volkswagen, Audi, Bentley, Lamborghini).

Figure 1. AUTOMAKERS' AVERAGE GLOBAL WARMING AND SMOG SCORES FOR MY2008 VEHICLES

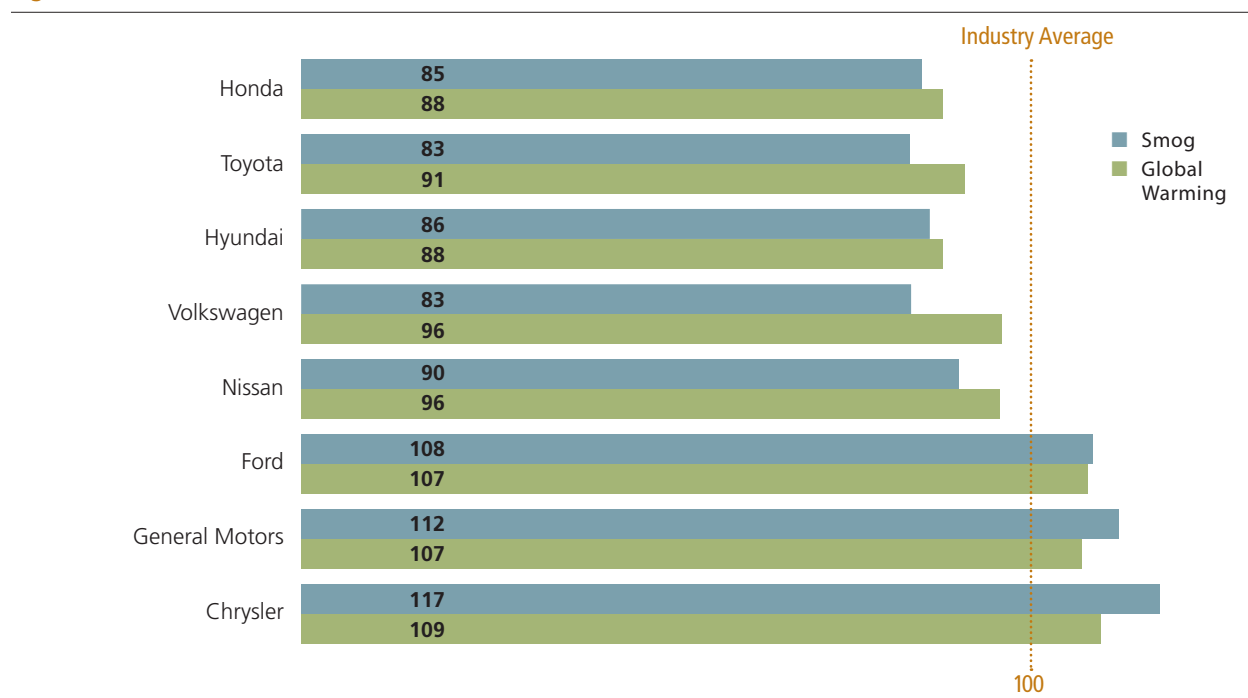


Table 2. OVERALL AUTOMAKER RANKINGS FOR AVERAGE NEW-VEHICLE EMISSIONS

RANK	MODEL YEAR 1998	MODEL YEAR 2001	MODEL YEAR 2003	MODEL YEAR 2005	MODEL YEAR 2008
1	Honda	Honda	Honda	Honda	Honda
2	Toyota	Toyota	Nissan	Toyota	Toyota* Hyundai*
3	Nissan	Nissan	Toyota	Hyundai	‡
4	GM	Ford	Ford	Nissan	Volkswagen
5	Ford	GM	DaimlerChrysler	Volkswagen	Nissan
6	DaimlerChrysler**	DaimlerChrysler	GM	Ford	Ford
7	†	†	†	GM	GM
8	†	†	†	DaimlerChrysler	Chrysler

* Scores for these two manufacturers are sufficiently close that they are both awarded a second-place ranking.

** During the period of the Daimler-Benz/Chrysler merger, DaimlerChrysler was evaluated as a single automaker that produced Mercedes-Benz and Chrysler products.

† Only the top six automakers were evaluated in model years 1998, 2001, and 2003.

‡ Because of a tie for second place, no automaker receives a third-place ranking.

Overall Fleet Trends

The rankings of the Top Eight manufacturers in MY2008 are similar to those of 2005, with two significant differences. This year, Hyundai moves up from third place into a tie for second, while Volkswagen's smog score lifts its overall score enough to edge out Nissan for the fourth-place finish.

Volkswagen's rise marks another disappointing outcome for Nissan, which falls for the second consecutive time in the rankings. Now in fifth place, as recently as MY2003 Nissan boasted the second-best overall score.

Another trend is the continued poor overall performance of the Detroit Three automakers, which, as shown in Table 2, have collectively been mired at the bottom of our lists (in varying order) in all five UCS automaker-rankings reports.

Comparing manufacturers' overall scores in this year's assessment to that of the past few years, two trends become apparent (Figure 2). First, the scores are getting closer. In MY2003, the spread between the best and worst manufacturers was more than 50 points. By MY2008, that difference has shrunk to less than 30 points.

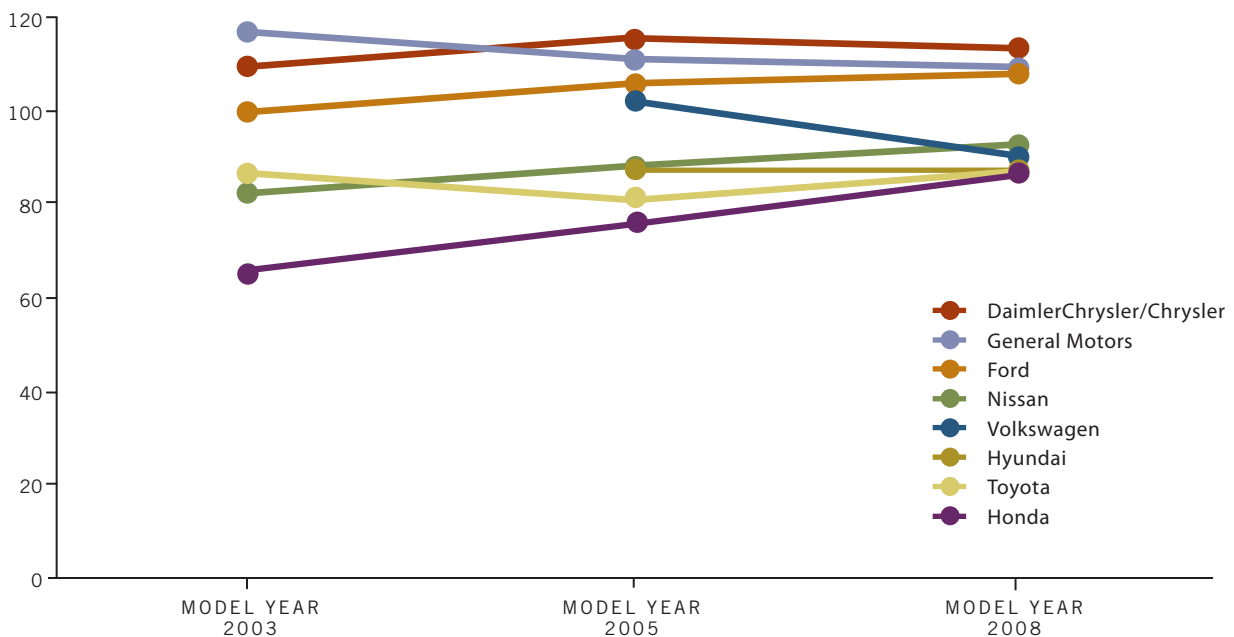
This narrowing of the gap between manufacturers is due in large part to the influence of government (federal as well as state) tailpipe emissions standards. By MY2008, the federal standards had been phased in to manufacturers' product lines, while the state standards continue to tighten through 2010. As manufacturers all

began to comply with stricter smog-forming emissions standards, all companies improved—especially the worst automakers, which were required to play catch-up. As of 2008, the same cannot be said for fuel economy, which—despite record gasoline prices—shows only modest increases, primarily from light-truck standards. (Far more substantial global warming and fuel economy standards, finalized in 2010, are set to begin in MY2012). Thus global warming emissions, which are tied in part to fuel economy, continue to be a differentiating factor in our rankings.

It is important to note that the scores shown in Figure 2 illustrate each automaker's pollution performance *relative to the average for each year*. Because the average gets better every year, an upturned line doesn't mean an automaker is getting worse. It just means the company is not keeping up with the industry. That is, each manufacturer's score depends not only on how well it does but also on how well its competitors do. This year, in most cases manufacturers show improvements in their average per-mile emissions levels, both for smog and global warming. (The only exceptions are Toyota and Volkswagen, which average slightly higher global warming emissions over their MY2005 fleets.)

Finally, another noticeable trend in Figure 2 is that two distinct groupings exist among the eight manufacturers—one group collectively better than average (i.e., with overall scores below 100) and the other group

Figure 2. AUTOMAKERS' OVERALL SCORES BY YEAR



collectively worse (with overall scores above 100). As noted above, the Detroit Three constitute the latter category, reflecting a disappointing trend driven by lower fuel economy relative to other manufacturers' offerings.

Smog Comparisons

All of the manufacturers have improved their per-mile smog-forming emissions this year, as California LEV II and federal Tier 2 emissions standards continue their phase-in. Still, some manufacturers' improvements are much more substantial than those of others, yielding a new ranking for smog-forming emissions performance.

Based on smog-forming emissions alone, Toyota and Volkswagen tie for the year's cleanest fleet (Table 3). Both manufacturers' fleets average 17 percent better than the average of all eight assessed automakers. Honda drops

from first place on smog (in all previous rankings) to third, while Hyundai comes in closely behind at fourth and Nissan falls from third to fifth. The Detroit Three, by contrast, sit well behind their competitors in terms of smog-forming emissions, occupying the bottom three rungs.

The standout in this year's smog assessment is Volkswagen, which jumped from sixth place to a tie for first place (Table 4). The explanation is that Volkswagen largely stopped producing diesel vehicles in MY2008. As a result of delayed upgrades to its diesel emissions controls, the automaker withheld these vehicles from its fleet so as to meet strict emissions regulations in California, its largest market. Volkswagen has since developed diesel models capable of meeting the California standards, so future iterations of the UCS automaker rankings

Table 3. MY2008 SMOG-FORMING EMISSIONS RESULTS

RANK	AUTOMAKER	SCORE
1	Toyota Volkswagen	83
3	Honda	85
4	Hyundai	86
5	Nissan	90
6	Ford	108
7	General Motors	112
8	Chrysler	117

Table 4. AUTOMAKER SMOG RANKINGS, MY2005 AND MY2008

RANK	MODEL YEAR 2005	MODEL YEAR 2008
1	Honda	Toyota Volkswagen
2	Toyota	†
3	Nissan	Honda
4	Hyundai	Hyundai
5	Ford	Nissan
6	Volkswagen	Ford
7	General Motors	General Motors
8	DaimlerChrysler	Chrysler

† Due to a tie for first place, no automaker receives a second-place ranking.

will chart how well the company does in actually cleaning up these vehicles. Meanwhile, with the elevated ranking of Volkswagen, Ford falls from fifth to sixth place.

Global Warming Comparisons

The automakers' performance on global warming emissions shows a slightly different picture, with Honda and Hyundai tying for first place, followed closely by Toyota (Table 5). Interestingly, despite edging out its competitors in the year's overall ranking, Honda does not claim a sole victory either in smog-forming or global warming emissions performance (where it places third and tied for first, respectively).

Hyundai, which in MY2005 placed fourth in the global warming category, jumped multiple spots to a tie for first place by reducing its fleet average global warming emissions 11 percent between model years 2005 and 2008 (Table 6). This is a notable achievement; by comparison, changes for the other seven automakers ranged from an increase of 1 percent to a decrease of 8 percent.

Volkswagen drops two spots this year, from third to fifth place, just barely edged out by Nissan, which moves up to fourth place. Volkswagen's fall in the global warming rankings is caused by a worsening of the company's average fuel economy from its MY2005 levels. Part of this decline is due to Volkswagen's removal of diesel models in MY2008, an action it took to meet tailpipe emissions regulations. The movement in Volkswagen's smog and global warming rankings in Tables 4 and

Table 5. MY2008 GLOBAL WARMING EMISSIONS RESULTS

RANK	AUTOMAKER	SCORE
1	Honda Hyundai	88
3	Toyota	91
4	Nissan	96
5	Volkswagen	96*
6	General Motors	107
7	Ford	107*
8	Chrysler	109

* Nissan and Volkswagen, as well as GM and Ford, are not exactly tied here. The listed numbers have been rounded to the nearest integer. For more information, see the appendix tables.

6 shows the emissions tradeoff in diesel technology between global warming and smog-forming pollution. (In this case, Volkswagen's improved smog score arising from the diesels' absence more than makes up for the company's decline in global warming score.) Volkswagen will have to show in future years that this tradeoff can be eliminated.

Meanwhile, General Motors, Ford, and Chrysler are again the bottom three, placements they have consistently held in our rankings (in varying order) over the past decade.

Table 6. AUTOMAKER GLOBAL WARMING RANKINGS, MY2005 AND MY2008

RANK	MODEL YEAR 2005	MODEL YEAR 2008
1	Honda	Honda Hyundai
2	Toyota	†
3	Volkswagen	Toyota
4	Hyundai	Nissan
5	Nissan	Volkswagen
6	General Motors	General Motors
7	Ford	Ford
8	DaimlerChrysler	Chrysler

† Due to a tie for first place, no automaker receives a second-place ranking.

Class Comparisons

Generally speaking, the cleanest automakers in the overall rankings also tend to have better emissions scores within individual classes. This is particularly true for the small and midsize car classes, which together account for three of every four cars sold in the United States, where Honda leads on small cars and Toyota and Hyundai lead on midsize cars. Similarly for SUVs, which represent more than 30 percent of the market: the three cleanest automakers also have the cleanest SUVs. Thus poor environmental performance cannot be blamed simply on product mix.

Figure 3 shows the combined pollution scores for various car classes, and the relative contributions of these scores' smog and global warming components. Each score is the overall average of a manufacturer's vehicles in the class. For example, Chrysler's midsize cars in MY2008 included the Chrysler Sebring as well as the Dodge Avenger, Dodge Challenger, and Dodge Caliber. Chrysler's midsize car score was therefore calculated as a sales-weighted average of each of these models.

Honda's small cars are the cleanest overall in that class; the best global warming score and second-best smog score allow the automaker to edge past its closest competitors, Hyundai and Toyota. In contrast, Chrysler produces the most polluting small cars on average, with worst-in-class scores both for smog and global warming. This year the smog portion of Chrysler's small-car score is a full 21 points above (i.e., worse than) that of its closest competitor and its total score is a full 36 points beyond the year's class average. In fact, Chrysler's small cars were worse for the environment than each company's fleet of *large* cars—even its own.

Toyota handily wins the midsize car class, with a sizable lead over its nearest rival in smog-forming emissions and a best-in-class global warming score. The worst automaker for the midsize car class is Chrysler, despite the company's besting of some competitors in global warming emissions. Once again, smog-forming emissions do the company in, as its 60-point score is more than double that of Toyota's and a full nine points above GM, the next biggest smog polluter in this class.

Honda wins in the large car class, though this is something of a hollow victory: the company's Accord four-door sedan squeaks into the Environmental Protection Agency's large car class definition, despite typically

competing with mid-size cars such as the Toyota Camry. The Accord four-door sedan's superior smog and global warming performance is sufficient to give Honda first place for large cars. A tie for worst large car automaker occurs between Volkswagen and Nissan; these companies' product offerings—including the Audi A8 L and Infiniti M-class sedans—produce worse-than-average emissions both for smog and global warming.

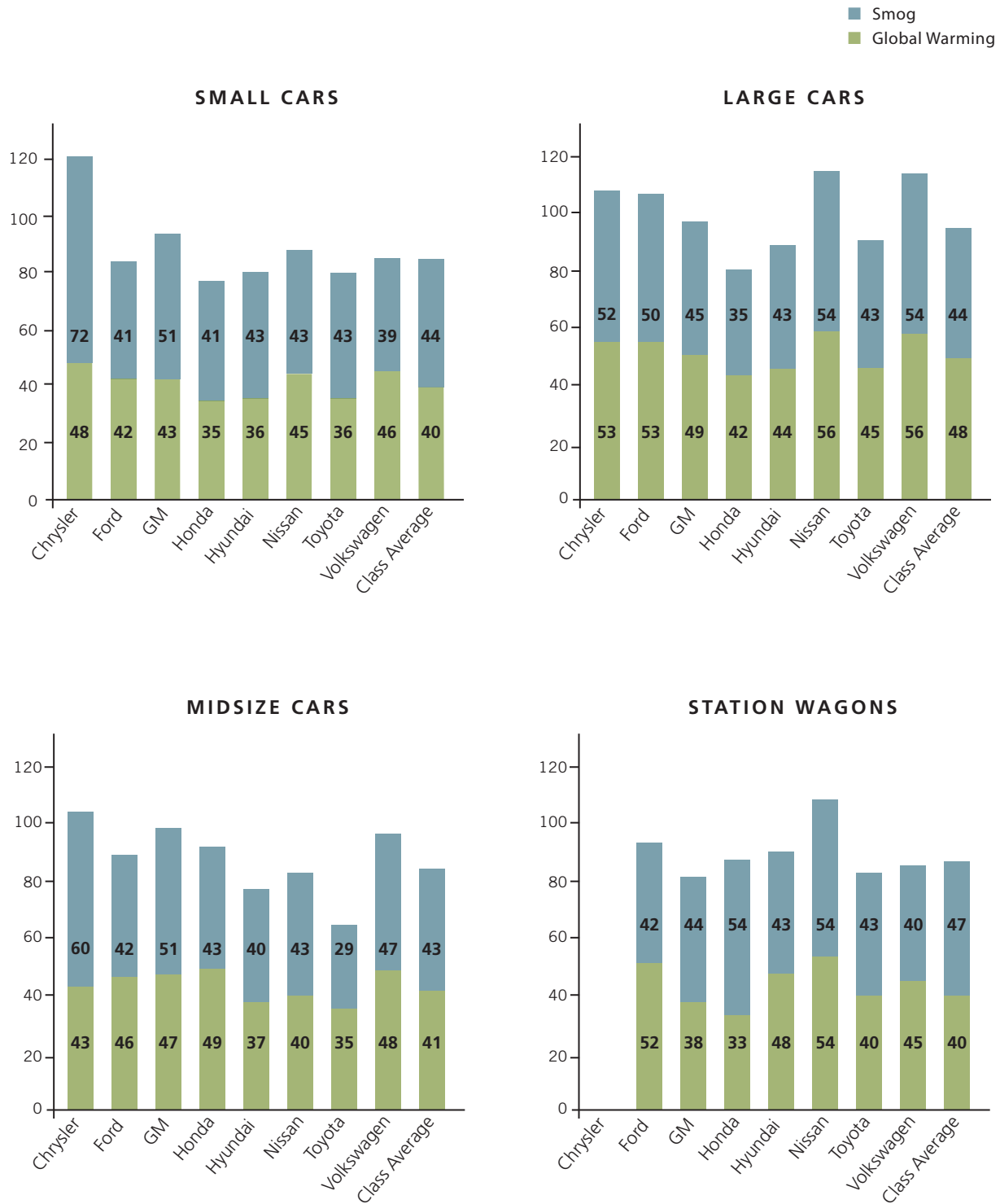
General Motors wins in the station wagon class, edging out its nearest competitor, Toyota. The only victory for the company in this year's rankings, GM actually accomplishes this feat without providing best-in-class performance either for smog or global warming emissions. (Hyundai and Toyota share the best smog score in the class while Honda has the best global warming score, but in terms of combined score, GM wins overall.) Nissan's Infiniti turns in the worst performance for this class this year through its single station wagon offering, the EX35.

Figure 4 (p. 10) shows the combined pollution scores of the three light-truck classes (pickups, SUVs, and minivans) together with the relative contributions of the smog and global warming components. Honda easily wins in the pickup class with its Ridgeline model, despite the fact that the Ridgeline's global warming score is only slightly better than the class average of 64. Honda claims the title for this class largely through smog-forming emissions performance, which under a fairly clean (for pickups) certification beats the scores of most of its competitors. Ford's fleet of pickups provides the worst environmental score in this class, primarily through high smog-forming emissions.

Toyota claims the cleanest SUV fleet in a hard-fought battle with Honda. While Toyota's global warming emissions are slightly higher than Honda's, lower smog-forming emissions are just enough to give Toyota the overall edge. The most polluting SUV fleet is that of Volkswagen, which pairs worst-in-class global warming emissions with well-above-average smog-forming emissions.

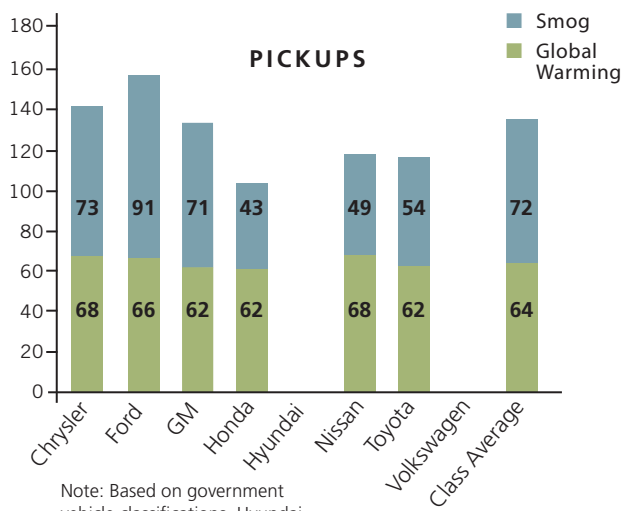
Finally, Ford and Nissan tie for the greenest minivan fleet this year, though there is relatively little variation between all of the manufacturers in this class. The nominally worst minivan fleet comes from GM, though its combined score of 109 is only five points above the minivan class average.

Figure 3. SMOG AND GLOBAL WARMING PORTIONS OF OVERALL SCORES OF CARS (BY CLASS)

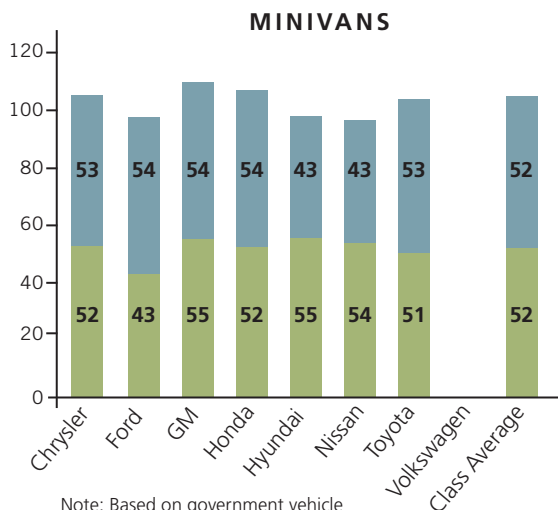
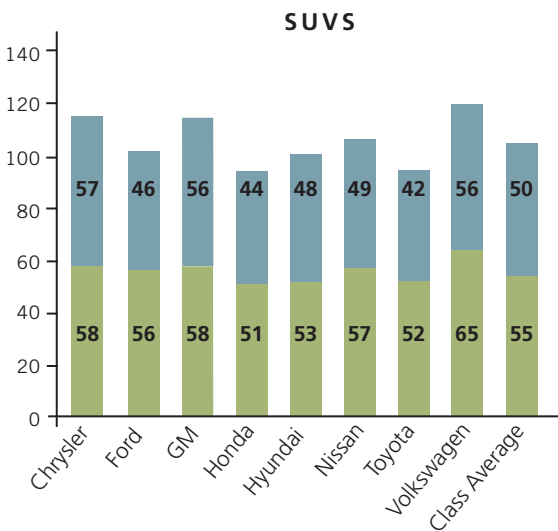


Note: Based on government vehicle classifications, Chrysler did not produce station wagons in MY2008.

Figure 4. SMOG AND GLOBAL WARMING PORTIONS OF OVERALL SCORES OF PICKUPS, SUVS, AND MINIVANS



Note: Based on government vehicle classifications, Hyundai and Volkswagen did not produce pickups in MY2008.



Note: Based on government vehicle classifications, Volkswagen did not produce minivans in MY2008.

Hybrids

One eco-friendly technology receiving a fair amount of attention over the past decade is the hybrid-electric vehicle (or “hybrid”), which potentially offers significant improvements over conventional vehicles both in terms of fuel economy and smog-forming emissions. But not all hybrids are created equal. The hybrid market includes “muscle hybrid” and “hollow hybrid” designs that provide marginal, if any, environmental benefits over comparable nonhybrid models.⁶

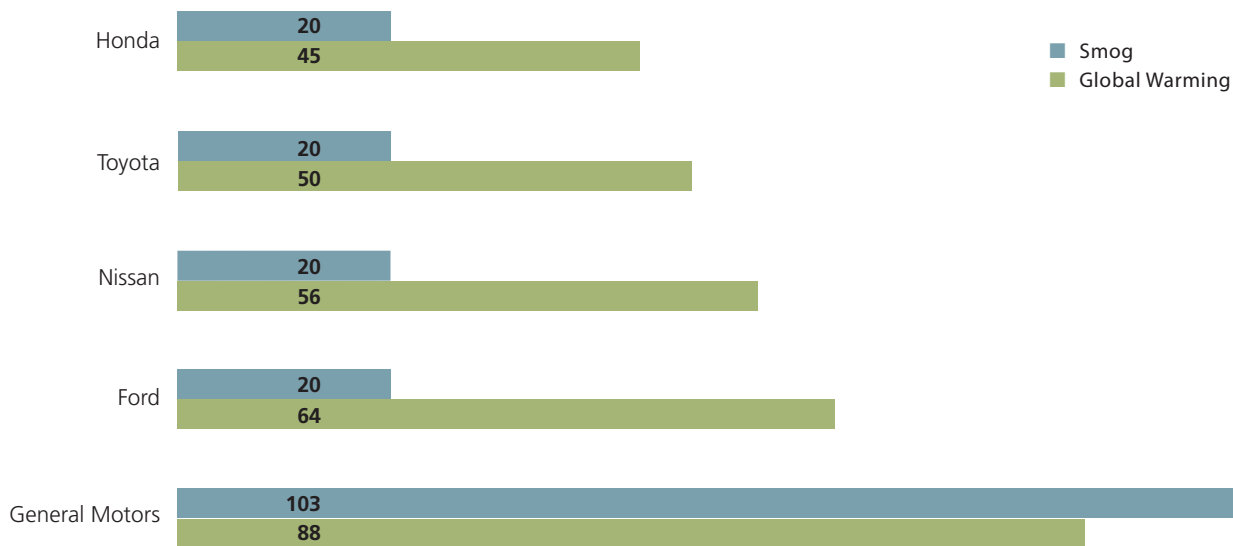
With this fact in mind, we assessed MY2008 hybrids to learn the answers to two key questions. First, which automaker’s collective fleet of hybrids is the most environmentally friendly? Second, what is the effect of each manufacturer’s hybrids on the company’s smog, global warming, and overall scores?

The greenest hybrid fleet. Despite the Toyota Prius being the greenest model on the market in 2008—offering the best performance both in terms of global warming and smog-forming emissions—Honda technically delivers the greenest hybrid fleet. This occurs for two reasons: Honda’s MY2008 fleet consists solely of the efficient Civic Hybrid; and Toyota’s fleet is watered down by muscle hybrids and some larger vehicles. Other companies’ hybrid offerings are less efficient than those of Honda and Toyota, on average.

Hybrids’ smog and global warming scores. Most of the five manufacturers that produced hybrids in MY2008 certified their hybrids to the cleanest non-zero emissions level available. Consequently, as illustrated in Figure 5, the hybrid fleets of Honda, Toyota, Nissan, and Ford all attain impressive smog scores of 20 points. GM’s hybrids, on the other hand, achieve tailpipe emissions certification at about the industry norm, resulting in a score of 103 points—3 percent worse than the average of all vehicles (hybrid and nonhybrid) assessed in this study.

The hybrid vehicles show more variability in their global warming scores, which are influenced by the vehicle-class mix of each automaker as well as by the sophistication of the technologies employed. Nissan’s global warming score of 56 points comes from the sole model in the company’s portfolio, the Altima Hybrid midsize sedan—a reasonably green family sedan—while Ford’s 64 points reflect the Escape Hybrid SUV

6 For more information on muscle and hollow hybrids, as well as individual rankings of all the hybrids on the market, visit Hybridcenter.org.

Figure 5. AUTOMAKERS' AVERAGE GLOBAL WARMING AND SMOG SCORES FOR MY2008 HYBRID VEHICLES

and its siblings, the Mercury Mariner Hybrid and Mazda Tribute Hybrid, which offer lower fuel economies than the Altima Hybrid but still stand out as the greenest SUVs on the market.

GM's bottom-rung score reflects, more than anything, a poor hybrid strategy. The company focused primarily on hollow hybrids, which offer minimal fuel savings, and on a different but promising "two-mode" hybrid design in its large trucks that unfortunately was mated to upsized, rather than downsized, engines. GM's hybrid scores do not result solely from large vehicles, however. In addition to the redoubtable GMC Yukon Hybrid and Chevrolet Tahoe Hybrid, GM's hybrid lineup in 2008 also included hybrid versions of midsize vehicles such as the Chevrolet Malibu sedan, Saturn Aura sedan, and Saturn Vue crossover.

Table 7 (p. 12) shows the effect of hybrid sales on each automaker's smog and global warming scores. With the exception of Toyota, that effect is minimal. On the other hand, Toyota sees a sizable improvement both in smog and global warming scores from the strong sales of its hybrid fleet.

Toyota's score improvements come largely from its Prius—far and away the company's most popular hybrid model. (Other models in the automaker's 2008 fleet in-

cluded the Camry Hybrid and Highlander Hybrid, along with the Lexus GS 450h, LS 600h L, and RX 400h.) As shown in Table 8 (p. 12), five points of the eight-point improvement in smog score are due to the Prius, as are four points of the five-point improvement in global warming score. All told, the Prius improves Toyota's overall score from 92 to 87. Put another way, without Prius sales Toyota would have placed fourth out of the eight automakers analyzed, behind Honda, Hyundai, and Volkswagen, while just edging out Nissan. These numbers attest that the environmental reputation Toyota enjoys from its Prius is, in many respects, justified.

Given the significant effect of Toyota's hybrid models on its overall score, it is clear that hybrids have the potential to play a key role in the greening of other automakers' fleets. A redoubled hybrid effort by Honda—including boosted sales and a design strategy focused on delivering peak fuel economy in most (if not all) classes—could reaffirm the company's hold on the title. Similarly, an aggressive hybrid strategy by Hyundai, which claims the best overall score of *non*hybrid models in this year's assessment, has the potential to yield a new overall UCS automaker-rankings winner in the future.

As of MY2008, GM's hybrid activities were still essentially a PR effort that had little or no impact on the

company's environmental bottom line. Since that time, GM has begun making improvements to its technology to achieve modest improvements in miles per gallon (mpg), though the resulting efficiencies are still not in line with those of other hybrids on the market. In addition to the poor eco-performance of GM's hybrids, another factor limiting its ability to move the needle was its weak sales, which amounted to a market share of less than 1 percent in MY2008.

Other companies face sales challenges as well. For example, despite having class-leading technology, the overall impact of Ford's hybrids was also marginalized because of modest sales.

Flexible-Fuel Vehicles

In contrast to hybrids, which even in small volumes are already reducing global warming emissions, flexible-

fuel vehicles (FFVs) currently *increase* such emissions. A loophole in the federal fuel economy law permits automakers to produce FFVs as a way of earning credit toward meeting Corporate Average Fuel Economy (CAFE) requirements. Under the policy, FFVs are ascribed a fuel economy approximately 65 percent higher than the vehicles' tested efficiencies. This inflated mpg is used for CAFE accounting to give automakers an incentive to produce vehicles that run on an alternative fuel. However, by producing sufficient numbers of FFVs, an automaker's fleet of non-FFV vehicles is consequently allowed to achieve worse fuel economy than the standard prescribed by law.

In theory, this loophole is supposed to create more vehicles that run on an alternative fuel. In practice, however, these vehicles almost never do. In MY2008, all of the FFVs sold could run on either gasoline or E85

Table 7. IMPACT OF HYBRIDS ON AUTOMAKERS' SMOG AND GLOBAL WARMING SCORES

AUTOMAKER	SMOG SCORE			GLOBAL WARMING SCORE		
	WITHOUT HYBRIDS	WITH HYBRIDS	IMPROVEMENT (POINTS)	WITHOUT HYBRIDS	WITH HYBRIDS	IMPROVEMENT (POINTS)
Ford	109	108	1	108	107	1
GM	112	112	0	107	107	0
Honda	86	85	1	89	88	1
Nissan	91	90	1	96	96	0
Toyota	91	83	8	96	91	5
Fleet Avg.	102	100	2	101	100	1

Table 8. IMPACT OF PRIUS AND OTHER HYBRIDS ON TOYOTA'S SCORES

	FLEET WITH NO HYBRIDS	FLEET WITH ALL HYBRIDS EXCEPT PRIUS	FLEET WITH ALL HYBRIDS INCLUDING PRIUS
Smog Score	91	88	83
Global Warming Score	96	95	91
Overall Score	94	92	87

(a fuel containing 85 percent denatured ethanol and 15 percent gasoline), and for the purpose of giving credits under the loophole, the government has assumed that FFVs operate on alternative fuels 50 percent of the time. But in reality there is limited usage—and availability—of such fuel. Today, FFVs run on E85 about 1 percent of the time (EIA 2010; MacKenzie, Bedsworth, and Friedman 2005). And for FFV drivers seeking out the fuel, E85 is available at only 1 percent of gas stations nationwide (AFDC 2010).

FFV advocates point to a law requiring a dramatic increase in the amount of ethanol produced in the United States in the coming years. However, an assessment of production volumes indicates that much of that fuel will be used in low-concentration blends of E10 (10 percent ethanol, 90 percent gasoline) burned in *conventional* cars and trucks, as opposed to being used to produce E85.⁷ And as long as FFVs continue to run on gasoline instead of E85, the FFV CAFE credits being granted to automakers will continue to undermine the credits' oil-savings purpose.

Table 9 shows the effect of MY2008 FFV sales on each manufacturer. A sizable mpg difference exists for the four manufacturers that installed FFV equipment on their vehicles in MY2008. While FFV-based CAFE credits are capped at 1.2 mpg per manufacturer, these results indicate that a number of companies have been exploiting the FFV loophole as a strategy for helping to meet corporate fuel economy obligations.

Table 9. DIFFERENCE IN MPG BETWEEN FLEET AVERAGE AND FFV-BOOSTED FLEET AVERAGE, MY2008

AUTOMAKER	MPG DIFFERENCE
Chrysler	1.37
Ford	1.26
General Motors	1.83
Honda	-
Hyundai	-
Nissan	1.10
Toyota	-
Volkswagen	-

7 The law, known as the Renewable Fuel Standard (RFS), requires sales of about 13 billion gallons of biofuels by 2010—enough to offset less than 9 billion gallons of gasoline, or about 7 percent of gasoline demand. By 2020 the RFS requires sales of about 30 billion gallons of biofuels—enough to offset about 20 billion gallons of gasoline, or about 15 percent of gasoline demand. Today, conventional gasoline can contain up to 10 percent ethanol by volume. If the Environmental Protection Agency changes current regulations to allow up to 15 percent ethanol by volume, all of the RFS-required ethanol use could be met through conventional gasoline. Thus no FFVs would be needed until after 2020.

Conclusions

The eight largest manufacturers in the U.S. market were responsible for 92 percent of the automobiles sold in MY2008. Along with that dominant market share comes the responsibility to deliver products with smaller environmental impacts. Yet vehicle emissions continue to have profound adverse effects on the environment, as automakers have collectively done very little to reduce vehicles' fuel consumption and global warming emissions over the past two and a half decades. While some progress has been made in recent years in reducing tailpipe emissions of smog-forming pollutants, there is room for further improvement in that area as well. Overall, greater consumer eco-awareness and the perception that automakers could be doing a great deal more have created a negative environmental image for many of these companies—an image they seek to change not necessarily through technological innovation but often by means of advertising and press releases.

Notable differences emerge among the automakers, however, when it comes to fleet-wide performance. Honda's and Toyota's reputations for delivering clean and efficient vehicles are borne out in the numbers, though compared with where the companies stood three years ago, their global warming emissions reduction efforts have stalled. Hyundai, meanwhile, has made dramatic improvements in its fleet global warming emissions, and it now stands poised to gain advantage from Honda's and Toyota's complacency. On the other end of the spectrum, the negative environmental reputations of the Detroit Three are not likely to change anytime soon, as their fleet-wide eco-performances continue to lag substantially behind those of their competitors.



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Individual Automaker Results and Key Recommendations

Honda wins the first-place title once again, though just barely, so the company cannot rest on its laurels. Given the photo finish in which Honda nosed out Toyota and Hyundai, it clearly needs to step up its environmental performance if it hopes to retain the title in future years. In particular, Honda must alter its hybrid efforts, focusing on efficient designs and significant hybrid sales across its fleet. Similarly, Honda would be well served to improve the environmental friendliness of its minivan fleet, which placed second to last among all manufacturers. Finally, while all manufacturers have improved tailpipe emissions in response to tightening regulations, Honda should seek to regain its historic leadership in smog-forming emissions control technology.

Toyota was poised to take the greenest-automaker crown from Honda this year based on past trends, but instead Toyota stalled; it made no progress on global warming emissions since our last analysis (391 grams/mile in MY2008 vs. 390 grams/mile in MY2005). Hybrids are very important to Toyota's automaker-rankings competitiveness—without them the company would have finished in fifth place this year—so to stay ahead of the pack it will have to expand on its top-performing hybrid models and disengage itself from the muscle variety. Making matters more challenging, dark horse Hyundai poses new competition. For Toyota to claim the mantle in our next analysis

(ca. 2012), it will need not only to maintain its lead in hybrid technology but also to make concurrent improvements in conventional technology.

Hyundai stands a very good chance of spoiling the party both for Honda and Toyota in the next automaker-rankings assessment, should the company maintain its focus on delivering clean and efficient products across all vehicle classes. Recent announcements by Hyundai, such as its decision to eschew six-cylinder engine configurations in lieu of four-cylinder versions, bode well for the company's chances. One key factor to watch will be Hyundai's hybrid strategy. Efficient product offerings in a range of classes yielding decent sales could boost Hyundai's eco-credibility; inefficient designs or limited product volumes, on the other hand, could translate into a PR ploy.

Volkswagen's lack of diesel models this year adversely (albeit only slightly) affected the company's global warming rating, but that impact was more than offset by the company's improvement in its smog score. The newer and cleaner diesel models that Volkswagen now offers will be technologies to watch—especially to see if they can beat out other companies' hybrids. If Volkswagen truly wants to be a contender, however, it needs to improve the efficiency of its gasoline-powered vehicles as well.

Nissan has a lot of work to do if it is to end the disappointing slide from its number-two ranking overall in MY2003. The company's decision to pursue an aggressive and very public electric vehicle campaign, beginning with its Leaf EV, poses an exciting wild card for Nissan's eco-credibility. But this model will have to be produced in high enough volumes to make a sizeable impact on the company's environmental bottom line. As Nissan moves forward in developing a portfolio of vehicle technologies, it must not neglect the conventional technologies that make up the lion's share of its sales.

Ford's sixth-place ranking is a disappointing position for a company that prides itself on its eco-credibility. Improving the smog performance of its pickups, as well as dumping flexible-fuel vehicles, should rank high on Ford's environmental agenda. Ford should also focus on increasing sales of its class-leading Escape and Fusion hybrids.

The automaker's introduction of EcoBoost engines, and its decision to seriously compete in the small-car market with the new Fiesta, could have a significant impact as well if enough of these products get into consumers' hands.

GM's pursuit of hollow hybrids, together with a two-mode hybrid system that focuses more on muscle, yielded few environmental benefits and weak sales. The company must abandon this fruitless approach to the technology and instead produce—in volume—efficient hybrid products that deliver sizeable emissions savings. While GM made respectable improvements in smog-forming emissions this year, its overall fleet yielded only a 2.8 percent reduction in per-mile global warming emissions compared with its fleet of three years ago. If GM wishes to become the greenest of the Detroit Three, it will need to step up its efforts to reduce global warming emissions in almost every class of car and truck it sells.

Chrysler is the dirtiest automaker of the year for the fourth time in five UCS automaker-rankings analyses, and it has consistently been among the bottom three for every vehicle class in which it competes. This out-of-touch company needs a major shake-up to start responding to consumers' interests, driven in large part by numerous adverse energy-related events around the world over the past decade. Chrysler must focus on the basics and begin implementing a long-term plan to catch up to its competitors.

Lessons Learned

Our by-the-numbers comparisons of the automakers reveal several important lessons for these companies as they vie for customers seeking cleaner vehicles:

Sales matter. Delivering an environmentally friendly fleet requires producing clean vehicles *and* selling them. Manufacturers have made many claims about their environmental stewardship, pointing to particular eco-friendly models. But as shown by the relative impacts of MY2008 hybrids, advanced technologies only make a difference when they're sold in volume. This fact has important implications for the upcoming Chevrolet Volt plug-in hybrid and Nissan Leaf EV, both of which offer significant environmental promise but will likely see

modest near-term sales. Moreover, while such technologies are inspirational, manufacturers seeking to make good on their claims of eco-stewardship need to focus as well on their fleets writ large. More mundane improvements to engines, transmissions, and after-treatment systems can have large overall and positive impacts on sales, the environment, and automakers' reputations.

Consistency is key. Manufacturers that rank at or near the top of our automaker rankings get there by delivering best- or near-best-in-class performance, both on smog and global warming, in all or most of the vehicle classes in which they compete. Honda and Toyota, for example, placed either first or second in four of seven class categories in which they competed. By contrast, Chrysler, which ranked last this year, placed first or second in none of its vehicle classes.

Full lines can compete. Honda and Toyota, which ran neck-and-neck for the greenest-automaker title this year, each produced vehicles in seven of the eight vehicle segments considered in this report. Hyundai, which tied with Toyota for second place overall, competed in six of the eight segments. Clearly, claim to the crown does not occur through production of small cars alone.

Standards work. This year saw marked improvement by all automakers in their per-mile smog-forming emissions. The achievement was prompted largely by federal Tier 2 and California LEV II emissions laws, which required the automakers to clean up their products. And while most of the companies made improvements in their global warming emissions as well, these changes were much more modest. As new fuel economy and global warming emissions standards are phased in over the coming years, however, we anticipate seeing progress in that pollutant segment too.

The difference of diesel. Past diesel vehicles have forced a losing tradeoff between global warming and smog-forming emissions, ultimately harming more than helping the automakers' green rankings. In MY2005, diesel technology clearly weighed Volkswagen down in its overall rankings, and the company's decision to dramatically cut back diesel offerings boosted its MY2008 position substantially. But as emissions control of diesel

engines improves, manufacturers may be able to offer diesels that do not undermine their global warming benefit with poorer-than-average smog-forming emissions levels. In future rankings, we will keep an eye out for the impact of cleaner diesel technology.

REFERENCES

- Alternative Fuels Data Center (AFDC). 2010. Alternative fueling station counts by state and fuel type. August. Online at http://www.afdc.energy.gov/afdc/fuels/stations_counts.html.
- Burnham, A., M. Wang, and P. Moon. 2006. *Energy and emission effects of the vehicle cycle*. Presented at SAE 2006 World Congress. April 3.
- Energy Information Administration (EIA). 2010. *Annual energy outlook 2010*. Washington, DC. April.
- Friedman, D., and D. MacKenzie. 2004. *Automaker rankings 2004: The environmental performance of car companies*. Cambridge, MA: Union of Concerned Scientists. December.
- MacKenzie, D. 2007. *Automaker rankings 2007: The environmental performance of car companies*. Cambridge, MA: Union of Concerned Scientists. April.
- MacKenzie, D., L. Bedsworth, and D. Friedman. 2005. *Fuel economy fraud: Closing the loopholes that increase U.S. oil dependence*. Cambridge, MA: Union of Concerned Scientists. August.
- Mark, J. 2002. *Automaker rankings: The environmental performance of car companies*. Cambridge, MA: Union of Concerned Scientists. September.
- Morey, C., R. Hwang, J. Kliesch, and J. DeCicco. 2000. *Pollution lineup: An environmental ranking of automakers*. Cambridge, MA: Union of Concerned Scientists. March.
- Weiss, M.A., J.B. Heywood, E.M. Drake, A. Schafer, and F.F. AuYeung. 2000. *On the road in 2020: A life-cycle analysis of new automobile technologies*. Energy Laboratory Report #MIT EL 00-003. Cambridge, MA: Massachusetts Institute of Technology. October.

APPENDIX

Detailed Data Tables

Table A-1. MY2008 SMOG-FORMING EMISSIONS RESULTS

RANK	AUTOMAKER	PER-MILE EMISSIONS (GRAMS)	SCORE
1	Toyota* Volkswagen*	0.122 0.123	83
3	Honda	0.125	85
4	Hyundai	0.127	86
5	Nissan	0.132	90
6	Ford	0.159	108
7	GM	0.165	112
8	Chrysler	0.173	117

* Scores for these two manufacturers are sufficiently close that they are both awarded a first-place ranking.

Table A-2. MY2008 GLOBAL WARMING EMISSIONS RESULTS

RANK	AUTOMAKER	PER-MILE EMISSIONS (GRAMS)	SCORE
1	Honda* Hyundai*	377 377	88
3	Toyota	390	91
4	Nissan	410	96
5	Volkswagen	411	96
6	GM	457	107
7	Ford	460	107
8	Chrysler	468	109

* Scores for these two manufacturers are sufficiently close that they are both awarded a first-place ranking.

Table A-3. AVERAGE SMOG-FORMING EMISSIONS (BY AUTOMAKER AND CLASS)

AUTOMAKER	SMALL CAR	MIDSIZE CAR	LARGE CAR	STATION WAGON	MINIVAN	PICKUP	SUV	VAN	FLEET AVERAGE
Chrysler	0.213	0.177	0.152	-	0.155	0.215	0.168	-	0.173
Ford	0.121	0.125	0.147	0.123	0.160	0.266	0.135	-	0.159
GM	0.149	0.150	0.134	0.129	0.160	0.210	0.166	0.160	0.165
Honda	0.121	0.125	0.104	0.160	0.160	0.125	0.128	-	0.125
Hyundai	0.126	0.116	0.125	0.125	0.125	-	0.140	-	0.127
Nissan	0.126	0.125	0.160	0.160	0.125	0.144	0.144	-	0.132
Toyota	0.127	0.085	0.125	0.125	0.156	0.160	0.123	-	0.122
Volkswagen	0.115	0.140	0.160	0.118	-	-	0.164	-	0.123
Top Eight Avg.	0.130	0.126	0.130	0.137	0.154	0.210	0.146	0.160	0.147

Notes: Results are expressed in grams per mile. Smog-forming emissions are the sum of the 100,000-mile or 120,000-mile certification levels for nitrogen oxides (NO_x) and nonmethane organic gases (NMOG), which are key precursors of smog. In-use emissions levels will likely vary significantly from these values.

A number in red indicates the class leader.

Table A-4. AVERAGE GLOBAL WARMING EMISSIONS (BY AUTOMAKER AND CLASS)

AUTOMAKER	SMALL CAR	MIDSIZE CAR	LARGE CAR	STATION WAGON	MINIVAN	PICKUP	SUV	VAN	FLEET AVERAGE
Chrysler	414	368	451	-	450	584	494	-	468
Ford	363	396	458	442	368	567	478	-	460
GM	366	401	418	326	469	532	496	551	457
Honda	304	421	361	283	448	528	433	-	377
Hyundai	310	320	375	410	475	-	453	-	377
Nissan	386	341	484	460	462	583	490	-	410
Toyota	312	300	384	344	433	535	448	-	390
Volkswagen	395	414	478	389	-	-	560	-	411
Top Eight Avg.	345	353	411	345	449	551	475	551	429

Notes: Results are expressed in grams CO₂-equivalent per mile, based on CAFE-test fuel economy and full-fuel-cycle emissions. CAFE-test fuel economy may be as much as 25 percent greater than real-world fuel economy, so actual in-use emissions will be higher for most drivers.

A number in red indicates the class leader.

AUTOMAKER RANKINGS 2010

THE ENVIRONMENTAL PERFORMANCE OF CAR COMPANIES

The product-planning decisions of a small number of automotive companies have an immense influence on the environmental health of the United States and the world. This UCS assessment, the fifth in a continuing project we have been conducting for 10 years, analyzes the bottom-line environmental performance of eight companies that together account for more than 90 percent of cars and trucks sold in the United States.

Using government data on model year 2008 vehicles, we evaluate each automaker's average per-mile emissions of smog-forming and global warming pollutants. Overall scores for each manufacturer are computed; the average across all eight automakers is defined as a score of 100, with lower scores indicating less pollution.



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