EarthTrends Featured Topic:

Car Companies & Climate Change: Measuring the Carbon Intensity of Sales and Profits.

Source: *Changing Drivers: The Impact of Climate Change on Competitiveness and Value Creation in the Automotive Industry*
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Carbon dioxide (CO2) emissions from automobiles and light trucks are a major contributor to climate change, particularly in the United States and other industrialized countries. In producing different vehicles for different markets, automobile manufacturing companies vary substantially in the amount of carbon emissions that come from their products. Some auto companies rely heavily for sales and profits on vehicles that emit relatively high amounts of CO2, while others derive the bulk of their profits from vehicles that are less carbon-intensive.

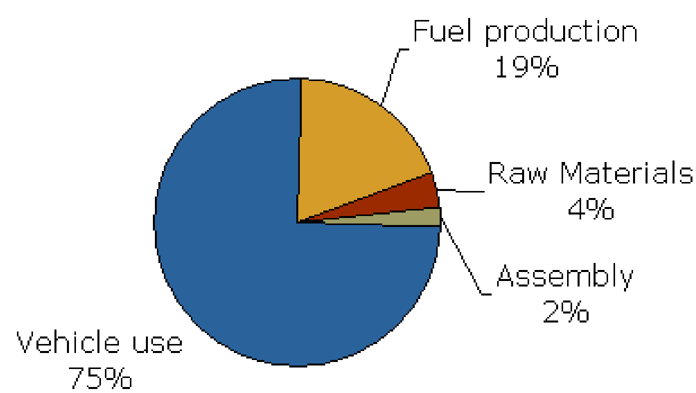
This feature will compare the "carbon intensity" of the 10 leading auto companies (BMW, DaimlerChrysler (DC), Ford, GM, Honda, PSA (Peugeot Citroen), Renault, Nissan, Toyota, and VW) by measuring the CO2 emissions associated with their current sales and profits. Not only is the carbon intensity of each company important for determining the amount of CO2 emissions that enter our atmosphere, it is also an important metric for determining a company's future financial performance. The carbon intensity of a company's vehicles will influence the company's ability to compete in the growing number of auto markets that have fuel economy or CO2 emissions requirements.

How do Cars and Trucks Contribute to Climate Change?

While CO2 emissions arise at nearly every stage of a motor vehicle's life—including extraction of raw materials and manufacturing of component parts—it is the combustion of gasoline and diesel fuels during vehicle use that accounts for the greatest share of vehicle-related CO2 emissions *(See Figure 1).*

A Day in the Life...

Figure 1: CO_2 Emissions from the Life Cycle of a Typical Vehicle



Source: Derived from Weiss et al, 2000.

Consequently, emissions from vehicle use are where effective climate policies are most likely to focus and where auto makers have the greatest scope to establish a competitive advantage over their rivals. While CO2 emissions can be reduced at the assembly stage—as some companies are showing—potentially much greater reductions are possible in the "use phase." Based on a 1996 Toyota Camry rated at 28 mpg, a 5 percent reduction in use phase emissions per vehicle will save 3.75 metric tons of CO2 over a vehicle's lifetime (3 metric tons from avoided gasoline combustion and 0.75 metric tons from avoided fuel production), while a 5 percent reduction in assembly-related emissions will save only 0.1 metric tons of CO2 per vehicle.

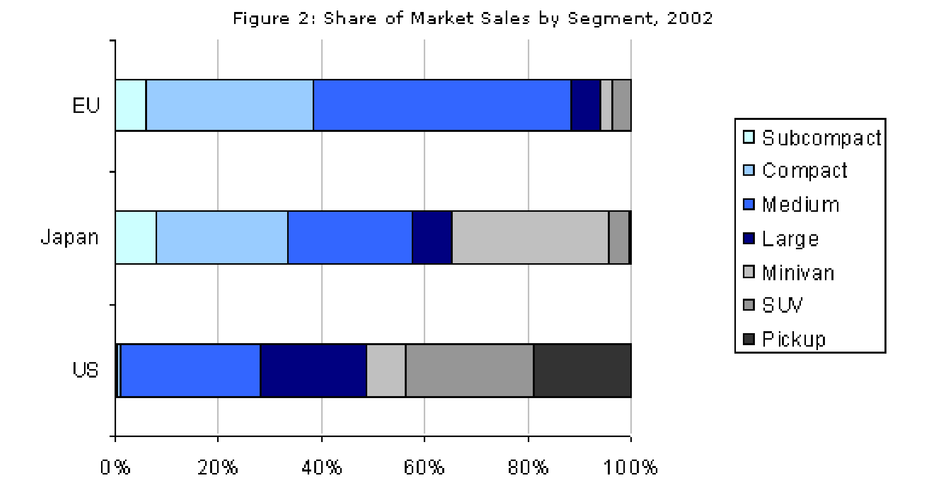
Figure 1 is also revealing of the different approaches taken by regulators around the world. Climate-related policies in the European Union, Japan, Canada, Australia and California have targeted the 94 percent of emissions directly or indirectly associated with vehicle use. In contrast, the US Administration's voluntary climate program encourages automobile manufacturers to reduce assembly-related emissions that make up just 2 percent of overall life-cycle emissions.

Why Do Automotive Companies have Different Carbon Intensities?

The following five factors influence the carbon emissions associated with auto companies:

- **The three main automotive markets demand different vehicle types.** Regional

Different Vehicle Types for Different Markets

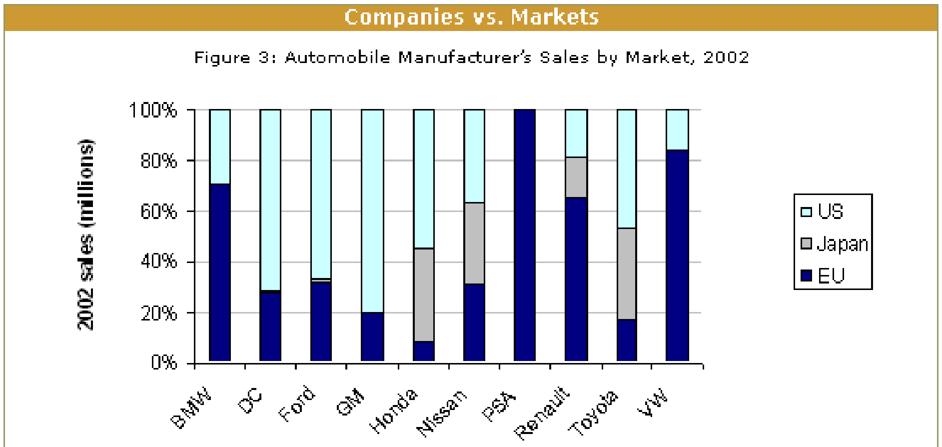


Source: Based on sales of the automobile manufacturers analyzed in Changing Drivers. WRI 2003. See Technical Notes for details.

differences in government regulations, demographics, transport infrastructure and consumer preferences create differential demand in the various markets *(See Figure 2)*. For example, in Europe and Japan, high fuel prices and smaller, more congested roads result in a strong consumer preference for small and midsized vehicles. In the United States, a greater share of light duty vehicle sales is made up of larger vehicles, including SUVs and pickups.

- **Auto companies' sales are differently distributed across the three main markets.** For example, PSA's sales are exclusively in Europe while the primary market for DC, Ford and GM is the United States. The Japanese companies are heavily invested in both Japan and the US *(See Figure 3)*.

Companies vs. Markets

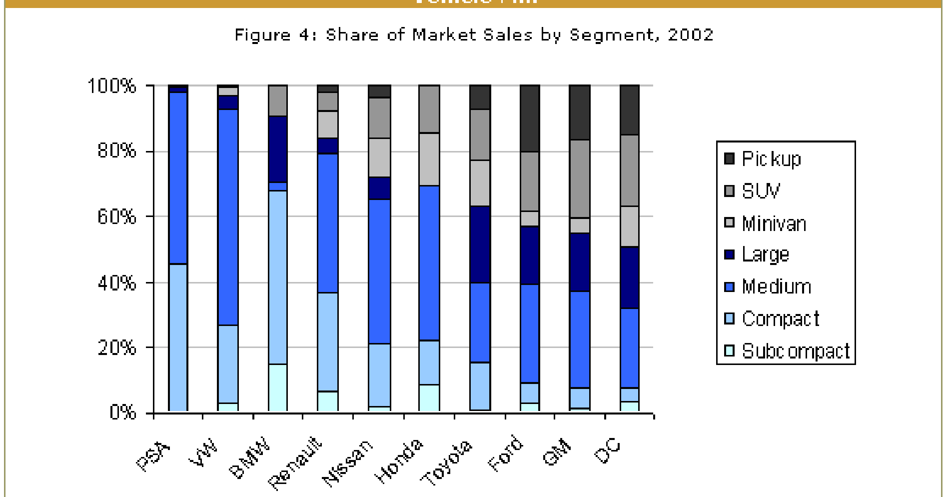


Source: WRI 2003. See Technical Notes for details.

- **Auto companies produce different mixes of vehicles.** With different geographical focuses, auto manufacturers concentrate on different vehicle segments. Nearly half of the vehicles that US-based auto companies sell are light trucks, such as minivans, SUVs and pickups. In contrast, cars make up more than 90 percent of sales for PSA, VW and BMW *(See Figure 4)*.

- **CO2 emissions rates vary across segments according to vehicle size and weight.** The global average CO2 emissions rate for a midsized car was 198 g CO2/km (28 mpg) in 2002, while the average SUV emitted more than 300 g CO2/km (less than 18 mpg) *(See Figure 5)*. On average, the emissions rates of SUVs and pickups are approximately twice those of subcompact and compact vehicles.

Vehicle Mix

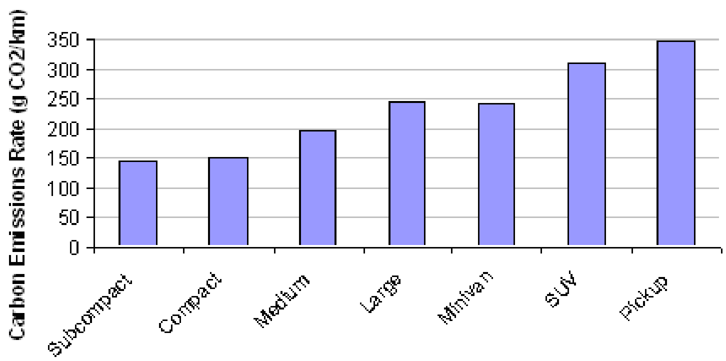


Note: Based on sales in the US, EU and Japan.
Source: WRI 2003. See Technical Notes for details.

- **CO2 emissions rates can also be substantially different within segments.** Emissions rates for midsized cars vary by 50 percent across automobile manufacturers and by 40 percent for SUVs. Within the SUV segment, Ford and GM's models are currently the most carbon-intensive, while Nissan, Toyota and Honda produce SUVs of lower than average carbon intensity. Some of this difference is due to the greater

Vehicle Size and CO_2 Emissions

Figure 5: Average CO_2 Emissions Rates by Segment, 2002



Source: WRI 2003. See Technical Notes for details.

concentration of the former auto companies in the full-size SUV market, and may change as the latter release larger and heavier SUVs.

How Is Carbon Intensity Measured?

Carbon Intensity of Sales

Given the above factors, vehicles sold by automobile manufacturers in 2002 exhibit markedly different average CO2 emissions rates. In other words, companies had different "carbon intensity of sales," which is one way to measure a company's carbon intensity *(See Figure 6)*. Virtually all of PSA's sales consist of vehicles whose carbon emissions are less than 200 g CO2/km (greater than 27.5 mpg). In contrast, DC, Ford and GM are the main sellers of high carbon-intensity vehicles.

Not all of the difference in carbon intensity of sales is due to the concentration of auto companies in different markets. For example, DC and Ford are among the top four automobile manufacturers by vehicle carbon intensity in all three markets *(See Figure 7)*. Similarly, Honda's and Nissan's fleets have below average carbon intensity in all three markets.

Carbon Intensity of Profits

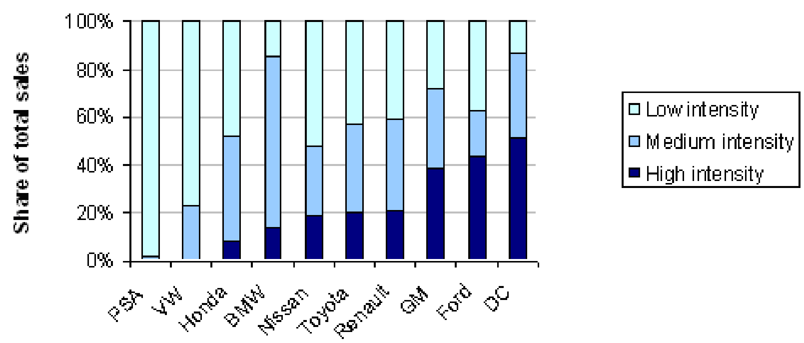
Because some segments of the vehicle market are more profitable than others, the carbon intensity of profits differs from the carbon intensity of sales. However, attributing profits to market segments is complicated by the large fixed costs in the industry and by significant general expenditures on such things as R&D and advertising.

Using profit figures obtained from leading financial institutions and the CO2 emissions rates of the different segments, we can illustrate the relative carbon intensity of profits *(See Figure 8)*. Again, PSA and Renault are least dependent on more carbon-intensive vehicles to generate profits, but Ford and GM derive more than three quarters of their profits from high carbon-emitting vehicles, because their profits are disproportionately attributable to light truck sales.

The assessment in this feature is a "snapshot" of where automobile manufacturers find themselves today. Naturally, data on current sales and fuel economy only indicates the current status of where companies are—not how they can, and will, respond to climate change or fuel economy regulations. However, measuring a company's carbon intensity provides insight into how they will be positioned to compete in an increasingly climate conscious global marketplace.

Carbon Intensity of Sales

Figure 6: Carbon Intensity of automobile manufacturers' Sales, 2002



Notes:
High: Greater than 270 g CO_2/km (less than 20.5 mpg).
Medium: 200 - 270 g CO_2/km (20.5 - 27.5 mpg).
Low: Less than 200 g CO_2/km (greater than 27.5 mpg).
Boundaries for high, medium and low categories were informed by the current CAFE standards for cars and light trucks, rounded slightly for convenience.
Source: WRI 2003. See Technical Notes for details.

Cross-market Intensity

Figure 7: Average CO_2 Emission Rates per Vehicle for Each Automotive Company by Region, 2002

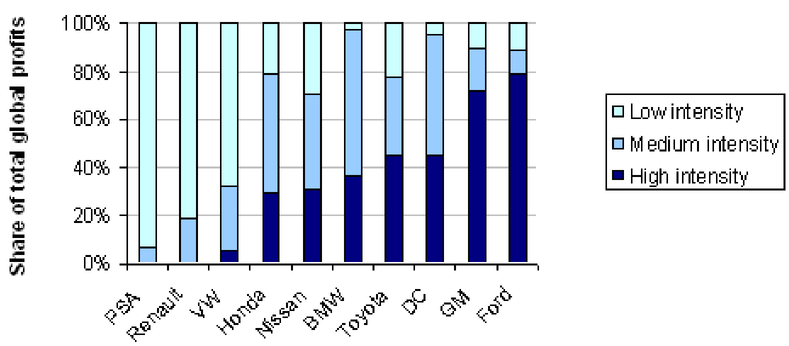
Company	United States		European Union		Japan	
	g CO2/km	Mpg	g CO2/km	Mpg	g CO2/km	Mpg
BMW	251	22	214	25.8	-	-
DC	282	19.6	234	23.6	230	24
Ford	295	18.7	196	28.2	212	26
GM	293	18.8	181	30.6	143 [a]	38.6 [a]
Honda	214	25.8	174	31.8	174	31.7
Nissan	242	22.8	159	34.8	185	29.8
PSA	-	-	166	33.2	-	-
Renault	242 [b]	22.8 [b]	149	37.1	185 [b]	29.8 [b]
Toyota	245	22.5	180	30.7	200	27.6
VW	220	25.1	179	30.7	-	-

Notes: Increasing CO_2 emissions rates (g CO_2/km) correspond to decreasing fuel economy (mpg).
a. GM's sales in Japan represent less than 8,000 sales of Suzuki and Isuzu vehicles, which represent GM's ownership stakes in these companies.
b. Renault's figures for the United States and Japan represent sales of vehicles by Nissan, in which Renault has a 44 percent ownership stake.

Source: WRI 2003. See Technical Notes for details.

Carbon Intensity of Profits

Figure 8: Carbon Intensity of automobile manufacturers' Profits, 2002



Notes:
High: Greater than 270 g CO_2/km (less than 20.5 mpg).
Medium: 200 - 270 g CO_2/km (20.5 - 27.5 mpg).
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Boundaries for high, medium and low categories were informed by the current CAFE standards for cars and light trucks, rounded slightly for convenience.
Source: WRI 2003. See Technical Notes for details.

REFERENCES

Austin, Duncan, Niki Rosinski, Amanda Sauer, and Colin Le Duc. 2003. *Changing Drivers: The impact of climate change on competitiveness and value creation in the automotive industry.* Washington, DC: World Resources Institute and WRI and Sustainable Asset Management (SAM).

This feature uses publicly available information from 2002 to assess each company's carbon intensity. The analysis is based on a dataset developed by SAM and WRI for Chnging Drivers report. 2002 sales data are from US and European editions of Automotive News and the Japan Automobile Dealers Association, which only includes domestic production in Japan. Data on fuel efficiency were obtained from the US Environmental Protection Agency and Department of Energy for US sales, from the German Federal Motor Transport Authority for EU sales, and from various company and industry data sources for Japanese sales.

Profit figures obtained by SAM Research from WestLB, Deutsche Bank Research, Goldman Sachs, Lehman Brothers and Schroder Salomon Smith Barney. These figures are available in Table 3.2 of the Changing Drivers report.