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Technical Report

Downward Trend in Passenger Car Fuel Economy-- a View of Recent Data

by

J. Dillard Murrell
and
Robert M. Heavenrich

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NOTICE

Technical Reports do not necessarily represent final EPA decisions or positions. They are intended to present technical analysis of issues using data which are currently available. The purpose in the release of such reports is to facilitate the exchange of technical information and to inform the public of technical developments which may form the basis for a final EPA decision, position or regulatory action.

U.S. Environmental Protection Agency
Office of Air and Radiation
Office of Mobile Sources
Emission Control Technology Division
Control Technology and Applications Branch
2565 Plymouth Road
Ann Arbor, Michigan 48105

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

ANN ARBOR, MICHIGAN 48105

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OFFICE OF
AIR AND RADIATION

MEMORANDUM

SUBJECT: Exemption From Peer and Administrative Review

FROM: Karl H. Hellman, Chief
Control Technology and Applications Branch

TO: Charles L. Gray, Jr., Director
Emission Control Technology Division

The attached report entitled "Downward Trend in Passenger Car Fuel Economy--A View of Recent Data," (EPA/AA/CTAB/90-01), is a brief analysis of the two-year trend in fuel economy from model year 1988 to model year 1990, and where the data may indicate fuel economy is headed.

Since this report is concerned only with the presentation of data and its analysis and does not involve matters of policy or regulations, your concurrence is requested to waive administrative review according to the policy outlined in your directive of April 22, 1982.

Concurrence: _____ Date: 2-6-90
Charles L. Gray, Jr., Dir., ECTD

Nonconcurrence: _____ Date: _____
Charles L. Gray, Jr., Dir., ECTD

cc: E. Burger, ECTD

Last year's technology and MPG trend report[1] noted an 0.4 MPG decline in average passenger car fuel economy from 1988. Regarded as possibly just a one-time blip in the curve, the decline was neither emphasized nor subjected to any close scrutiny.

The model year 1990 data is in, and it shows another decline in fuel economy-- it is now a two-year trend. If this backslide continues, problems with nationwide fuel consumption will increase and global warming trends will worsen at a pace faster than is generally being assumed by analysts. Thus it is appropriate to explore some of the characteristics of, and causes for, of the downward MPG trend.

The data used for this report come from the auto manufacturers, and represent their forecasts of production for the U.S. market. For the current model year and its predecessor year (prior to finalization of the official data for fuel economy standards compliance), the data are furnished for, and used primarily for, the fuel economy labeling and Gas Mileage Guide programs. The data are checked against subsequent, but still pre-model-year, MPG and production volume figures furnished by the manufacturers to the Department of Transportation and to the trade press, and adjusted accordingly. All MPG figures herein are EPA combined city-highway, "55/45" MPG; no on-road or test procedure correction factors have been applied to any of the MPG data. Vehicle weights are "inertia weight," i.e. curb weight plus 300 lbs.

Table 1 summarizes the two-year MPG decline for the passenger car fleet from 1988 to 1990, and the corresponding trends in vehicle weight and engine and acceleration characteristics (to prevent inter-year changes in the sales mix among manufacturers from distorting the comparison, the 1990 mix was also used with the 1988 data).

From 1988 to 1990, there was a 4% decline in MPG and a 6% weight gain; yet, average zero-to-60 MPH acceleration time* continued to decrease, due to the 10% increase in average engine horsepower. The horsepower increase is the result of a 7% gain in average engine power density (HP per cubic inch) and a 4% rise in average cubic inch displacement.

The fleet-level trends are mirrored directionally in all three of the major market sectors (import figures include cars built in the U.S. by foreign companies, and cars built overseas for sale by U.S. companies). Domestic cars, European cars, and Asian cars all lost MPG, with Asian car MPG dropping at a rate at least double that of the other two sectors. All three sectors gained weight, with Asian cars gaining it at a rate more than double that of the other two. All three sectors boosted horsepower (more than enough to offset their weight gain), with Asian cars increasing in average horsepower at a rate three times that of the Europeans and more than four times that of the Domestics.

The method used to increase power differs from sector to sector: the Europeans' power gain was due entirely to power density improvements, while the Domestics' and Asians' power increases came by adding CID increases on top of HP/CID increases, in about equal proportions. Asian cars' average CID is increasing by 5% a year, and HP/CID even faster.

Given no more information than that the above parameters of concern are changing in the same direction across all three market sectors, it could be inferred that all manufacturers in each sector share/contribute equally in the sector's behavior. However, only one or two high-selling manufacturers in a sector could be driving the sector averages; hence it is pertinent to examine the data across the manufacturers in each sector.

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* estimated; see [2].

Table 2 shows several aspects of the fuel economy trend, by manufacturer. The 22 manufacturers shown are the top-sellers; of the total projected 1990 sales, each represents 0.1% or greater, and together they represent more than 98%. The upper part of the table lists those with MPG declines between 1988 and 1990; the lower part lists those four whose MPG did not drop in that interval.

The first numeric column in Table 2 shows the 1988 to 1990 MPG change for each manufacturer: the eight greatest losses were posted by Asian companies, the Domestics appear in the lower half of the upper (backsliding) group, and three of the four non-backsliding manufacturers are European.

The second and third columns are reminders that MPG backsliding has been going on for more than just the last two years. Comparing each manufacturer's 1990 MPG to its highest average, whenever it occurred, all these companies except Yugo have lost MPG to some degree; of the ten who have lost it in double figures, seven are Japanese, three German. Some companies have a history of several consecutive years of MPG backsliding.

The two rightmost columns give linear projections of the two-year MPG trend: if the current rates of decline continue, 15 of the 18 backsliding manufacturers (including all three Domestics) will drop below 25 MPG before the end of the decade; the fleet will drop below 25 MPG by 1995.

Table 3 shows the 1988 to 1990 change in average weight by manufacturer. All except BMW gained weight, and all who gained in double figures are Japanese. The figures for Mitsubishi and Daewoo do not fit the pattern of other Asian companies.

Table 4 gives the two-year change in performance capability. All manufacturers in double figures are Asian. Again, the Mitsubishi and Daewoo figures do not appear to be typically "Asian". Ford is not on the performance-increase track of the other Domestics.

The magnitudes of the horsepower increases in Table 5 are surprisingly large compared to past trends. More than half the manufacturers are increasing their average power in double figures; Asian manufacturers lead the power growth trend; in fact, every Japanese manufacturer except Mitsubishi is increasing power in double figures.

The two-year trends in engine specific power, Table 6, and engine displacement, Table 7, follow the pattern seen above: where there are double-figure increases there are Asian companies. Five of the six companies who held average CID constant, or decreased it (Table 7), still gained in average power (Table 5) by improving power density (Table 6).

Light-duty trucks have a downward trend in fuel economy too: see Table 8.

References

1. Heavenrich and Murrell, "Light Duty Automotive Technology and Fuel Economy Trends Through 1989," Report EPA/AA/CTAB/89-04, May 1989.

2. Heavenrich, Murrell, and Cheng, "Light Duty Automotive Fuel Economy and Technology Trends Through 1987," SAE Paper 871088, May 1987.

Table 1
Two-year Trend: Percent Change, 1988 to 1990 Models

	Fleet	Domestic	European	Asian
A. 55/45 MPG	-4	-3	-2	-6
B. Weight	6	4	4	9
C. 0-60 Time	-4	-1	-3	-9
D. Horsepower	10	5	8	22
E. Engine HP/CID	7	3	8	11
F. Engine CID	4	2	0	10

Note: the 1988 figures use the 1990 mix of sales volumes by manufacturer.

Table 2
Manufacturers Decreasing Their Average Fuel Economy

Manufacturer	% Change in Co.Avg.F.E. 1988 to 90	% Change in Co.Avg.F.E. Max. to 90	No. Consecutive Years of MPG Decline	*Linear Projection: Year to Drop Below:* *30 MPG*	*25 MPG*
Isuzu	-9	-13		*1993*	*1996*
Toyota	-9	-10	3	***now***	*1994*
Subaru	-9	-9		***now***	*1993*
Nissan	-8	-15		***now***	*1993*
Diahatsu	-8	-8	2	*1997*	*2000*
Hyundai	-7	-7	2	*1993*	*1997*
NUMMI	-6	-10		*1993*	*1998*
Mazda	-5	-17		***now***	*1996*
Honda	-4	-13	7	*1991*	*1999*
Chrysler	-4	-4	2	***now***	*1994*
Volvo	-4	-7	4	***now***	***now***
Saab	-3	-3	2	***now***	*1991*
VW-Audi	-3	-16	2	***now***	*1998*
GM	-3	-3	2	***now***	*1995*
Ford	-2	-3		***now***	*1994*
Jaguar	-2	-2		***now***	***now***
Daewoo/GM	-2	-2		*>2000*	*>2000*
Suzuki	-1	-12		*>2000*	*>2000*

Manufacturers Not Decreasing Their Average Fuel Economy

Manufacturer	% Change in Co.Avg.F.E. 1988 to 90	% Change in Co.Avg.F.E. Max. to 90
Mitsubishi	0	-8
Yugo	0	0
Mercedes	0	-21
BMW	3	-19

Table 3

Manufacturers Increasing Their Average Weight

Manufacturer	% Change in Avg. Weight 1988 to 90
Subaru	16
Toyota	13
Suzuki	12
Isuzu	11
NUMMI	10
Nissan	9
Mazda	8
Chrysler	8
Diahatsu	8
Hyundai	7
Honda	5
VW-Audi	5
Mercedes	5
Volvo	4
Ford	4
Saab	3
GM	3
Mitsubishi	2
Daewoo/GM	2
Yugo	1
Jaguar	1

Manufacturer Not Increasing Its Average Weight

Manufacturer	% Change in Avg. Weight 1988 to 90
BMW	-1

Table 4

Manufacturers Increasing Their Acceleration Performance

Manufacturer	% Change in 0–60 Time, 1988 to 90
Nissan	−23
Isuzu	−18
NUMMI	−17
Hyundai	−16
Diahatsu	−12
Jaguar	−8
Subaru	−7
BMW	−6
Mazda	−6
Volvo	−6
Suzuki	−5
GM	−5
Honda	−4
Saab	−4
Daewoo/GM	−3
Toyota	−3
Chrysler	−3

Manufacturers Not Increasing Their Acceleration Performance

Manufacturer	% Change in 0–60 Time, 1988 to 90
Yugo	0
VW–Audi	0
Mercedes	0
Mitsubishi	3
Ford	8

Table 5

Manufacturers Increasing Their Average Horsepower

Manufacturer	% Change in Engine HP 1988 to 90
Nissan	51
Isuzu	43
NUMMI	37
Hyundai	35
Diahatsu	31
Subaru	29
Suzuki	21
Toyota	20
Mazda	16
Volvo	12
Jaguar	12
Chrysler	11
Honda	11
GM	10
Saab	8
VW-Audi	8
Daewoo/GM	7
Mercedes	6
BMW	6
Yugo	2

Manufacturers Not Increasing Their Average Horsepower

Manufacturer	% Change in Engine HP 1988 to 90
Mitsubishi	-2
Ford	-6

Table 6

Manufacturers Increasing Their Engine Power Density

Manufacturer	% Change in HP/CID 1988 to 90
Isuzu	39
NUMMI	37
Nissan	23
Suzuki	18
Volvo	13
Mercedes	13
Hyundai	13
Diahatsu	11
Subaru	10
BMW	10
Toyota	8
Saab	8
GM	8
Mitsubishi	7
Chrysler	6
Honda	5
Mazda	5
Jaguar	4
VW-Audi	3
Daewoo/GM	1

Manufacturers Not Increasing Their Engine Power Density

Manufacturer	% Change in HP/CID 1988 to 90
Yugo	0
Ford	-9

Table 7

Manufacturers Increasing Their Engine Displacement

Manufacturer	% Change in Engine CID 1988 to 90
Nissan	23
Hyundai	20
Diahatsu	18
Subaru	17
Toyota	11
Mazda	11
Jaguar	7
Daewoo/GM	6
Honda	5
Chrysler	5
VW-Audi	4
Isuzu	3
Suzuki	3
Ford	2
Yugo	2
GM	1

Manufacturers Not Increasing Their Engine Displacement

Manufacturer	% Change in Engine CID 1988 to 90
Saab	0
NUMMI	0
Volvo	-1
BMW	-4
Mercedes	-6
Mitsubishi	-9

Table 8
Three-year MPG Trend, Light Trucks: Percent Change, 1987 to 1990 Models

	% Change in Avg. F.E. 1987 to 90
Fleet	-1
Domestic	0
Chrysler	5
GM	3
Ford	-6
Grumman	-6
European	7
Volkswagen	11
Rover	-1
Asian	-10
Nissan	4
Suzuki	-3
Mazda	-6
Toyota	-13
Mitsubishi	-16
Isuzu	-19

Appendix

It is appropriate to show more detail for some specific cases to illustrate how trends in some of these technical parameters are influenced. We have chosen two cases where engine size and horsepower changes are noteworthy; the two cases are Ford, whose overall results indicate a decrease in average power density (horsepower per CID), and Nissan, who had the largest average horsepower increase.

The tables below show how changes in engine offerings and sales mix shifts among them combine to produce changes in sales-weighted average values for CID and horsepower and, correspondingly, power density. The Ford trend is a result of sales shifts away from higher horsepower versions within each engine type. Nissan's trend results from higher CID offerings, higher powered versions within them, and sales shifts (both within and among the engines) toward higher power.

1988 Ford Engines:

Cylinders	CID	Hp Versions
4	113	81,84,90,108
4	140	96,98,100, 151,194
4	152	88
Avg.4	129	99
6	182	140
6	231	150
Avg.6	206	145
8	302	150,220
8	351	180
Avg.8	303	192
Co.Avg.	201	139

1990 Ford Engines:

Cylinders	CID	Hp Versions
4	113	84,90,108
4	140	96,98,100
4	152	88
Avg.4	132	95
6	182	140,220
6	231	120,140,210
Avg.6	209	140
8	302	150,225
8	351	180
Avg.8	304	162
Co.Avg.	206	130

1988 Nissan Engines:

Cylinders	CID	Hp Versions
4	98	70
4	110	125
4	120	94,97,99
Avg.4	103	78
6	181	157,165,205
Avg.6	181	160
Co.Avg.	120	96

1990 Nissan Engines:

Cylinders	CID	Hp Versions
4	98	90
4	110	125
4	146	138,140
Avg.4	117	110
6	181	160,225,280
Avg.6	181	186
8	274	278
Co.Avg.	148	146