EPA/AA/CTAB/89-08

Technical Report

Options For Controlling the Global Warming Impact From Motor Vehicles

by

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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.

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OFFICE OF
AIR AND RADIATION

JAN 23 1990

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 "Options for Controlling the Global Warming Impact From Motor Vehicles" (EPA/AA/CTAB/89-08), discusses ways to form control approaches that could be involved in a regulatory program for control of carbon dioxide emissions from cars and light trucks.

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: Charles Gray, Jr. Date: 1-16-90
Charles L. Gray, Jr., Dir., ECTD

Nonconcurrence: ____________ Date: ________
Charles L. Gray, Jr., Dir., ECTD

cc: E. Burger, ECTD

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I. Abstract

There is a great deal of interest in the subject of global warming and potential ways to mitigate the impacts of emissions that contribute to global warming. This paper discusses ways to formulate approaches that could be involved in a regulatory program for control of carbon dioxide emissions from cars and light trucks.

II. Introduction

The worldwide problem of global warming has been the subject of a substantial amount of interest for several years now. Recent publications [1-4]* provide an overview of the subject that indicates the magnitude and complexity of the problem. EPA is currently studying the overall problem and investigating the various routes toward mitigation of the problem, as are others.[5,6]

In all the studies that have looked at the potential for reducing the emissions that contribute to global warming, the transportation sector has been identified as a key sector for any future reductions, if reductions are necessary.

If control of global warming emissions is necessary for the transportation sector, it is of interest to investigate ways in which the requirements for controls could be structured.

This paper concentrates on the passenger car and light truck sectors of transportation and presents ways in which regulatory programs for them could be constructed.

III. Carbon Dioxide As the Example Pollutant

Cars and light trucks emit four primary gases of concern with respect to global warming: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and chloroflourocarbons (CFCs). In the general case, a global warming index could be constructed for each vehicle as the basic building block for control purposes. This index would be the sum of the mass of each of the four pollutants multiplied by their respective global warming potential per unit mass.

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* Numbers in brackets denote references listed at the end of the paper.

Chloroflourocarbons (CFCs) are not treated in this paper because it appears that their contribution to global warming from vehicles will be approached by the material substitution route. Since all practical near-term fuels for vehicles contain carbon, material substitution as an approach to the problem is not practical and a reduction in the amount of CO_2 emitted is the major route toward mitigating the impact of vehicle emissions on global warming.

We have chosen to use CO_2 as the example for this paper for three reasons: 1) CO_2 accounts for nearly half of the global warming effects of all greenhouse gases, 2) by far the bulk of the emissions generated by cars and light trucks is CO_2, and 3) if the refinement of adding the other pollutants is necessary, their impacts can be taken care of by computing the global warming index in terms of CO_2 equivalents. Therefore, the use of CO_2 as an example in this paper could serve to explore the control concepts and those concepts can be extended to include the other pollutants, if necessary. Appendix A provides an example of an approach that could be used.

IV. Basic Approach

There are three aspects of any sort of regulatory requirement that are key to determining the overall stringency of the requirement. They are: 1) the baseline year, 2) the form of the requirement, and 3) value of quantitative improvement required. For this paper two baseline years were studied: 1978 and 1988. Since we wanted to include the possibility of combining cars and light trucks into the same fleet, we chose 1978 as one illustrative baseline year because it was the first year in which cars and light trucks were both subject to fuel economy standards. In some legislation that has been proposed, for example H.R.1078 of the 101st Congress, 1988 is selected as the base year from which to require improvements, so 1988 was also selected as a base year for this study. Although 1974 has not been considered a base year, it is worth noting that the U.S. Domestic carmakers have approximately doubled their 1974 MPG.

Two possible forms of the requirement were studied: the option of combining cars and light trucks into one fleet was considered, along with keeping the fleets separate as they are now. Considering the sales-weighted grams of CO_2 per vehicle mile provided a logical starting point since the requirement applies more to the emission of vehicles in the aggregate rather than to specific vehicles.

Considering cars and trucks together or separately and considering the measure of CO_2 in sales-weighted grams per vehicle mile gives the cases to study as shown in Table 1.

Table 1

Approaches Considered

Vehicles	Grams Per Vehicle Mile
Cars + trucks combined	$f_c(CO_2)_c + f_t(CO_2)_t$
Cars only	$(CO_2)_c$
Trucks only	$(CO_2)_t$

Where:

n_c = Numbers of cars

n_t = Numbers of trucks

$(CO_2)_c$ = Sales-weighted grams per mile of CO_2 for cars

$(CO_2)_t$ = Sales-weighted grams per mile of CO_2 for trucks

f_c = $n_c/(n_c + n_t)$

f_t = $n_t/(n_c + n_t)$

For the methods studied, a reduction in CO_2 emissions is an improvement.

The CO_2 emissions per vehicle are calculated from known MPG values using the relationship discussed in Appendix B:

$$CO_2 = \frac{8777}{MPG}$$

The database used to generate the data in this paper is described in detail in reference 7, as are the methods used to classify vehicles as Domestic, European, or Asian passenger cars or as Domestic or Imported light trucks.

The data used to generate the figures in this report are tabulated in Appendix C. Figures 1 and 2 show trends in CO_2 for cars and trucks together since 1978, on an absolute basis in Figure 1 and on a relative basis in Figure 2. Figure 1 indicates that reductions in overall CO_2 emissions have taken place since 1978. Figures 1 and 2 can be read to indicate that the Domestic passenger car class is the only one that has reduced its CO_2 emissions both on an absolute and on a percentage basis.

Figures 3, 4, and 5 show some of the details behind the overall trends. In terms of CO_2 per vehicle per mile, Figure 3 shows the Domestics making the largest improvements (over 25 percent), the Asians improving less than 10 percent, and the Europeans making essentially no change.

Figures 4 and 5 show that the car and truck trends taken separately lead to the same conclusions as the combined car and truck fleet.

Figures 6 through 10 show trends in CO_2 and values of possible future standards in various Bills being considered by Congress: H.R. 1078, S.1224, and S.1630. The values used for H.R. 1078 and S.1224 both use 1988 as the base so the figures are normalized to (divided by) the 1988 value. The miles per gallon improvements in the two Bills were converted to CO_2 reductions. For S.1630, the values in the Bill of 242 and 170 grams per mile are plotted along with the trend in CO_2 emissions in grams per mile.

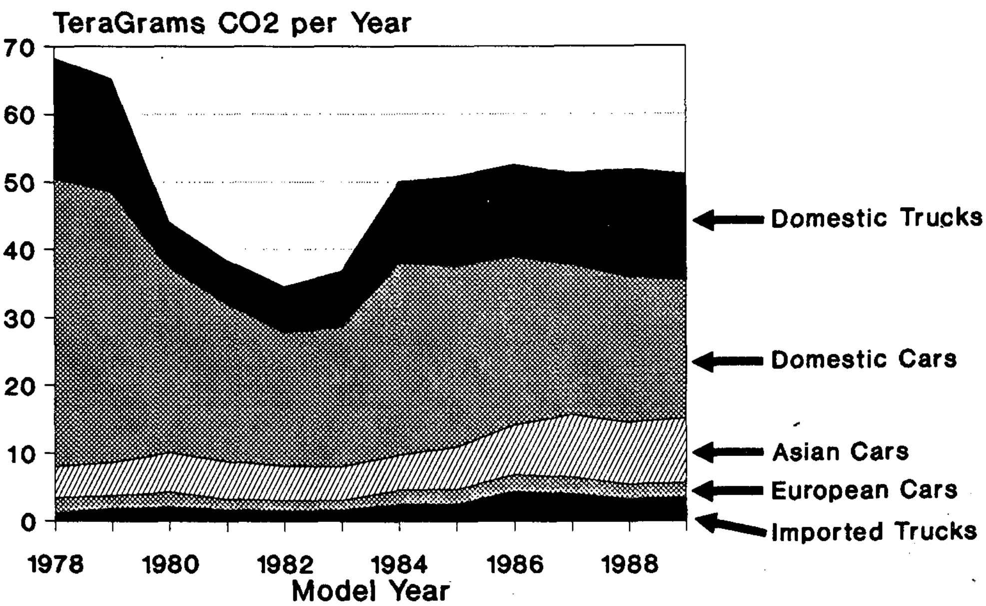

Figure 1 - Total CO2 per Year
by Vehicle Type & Origin

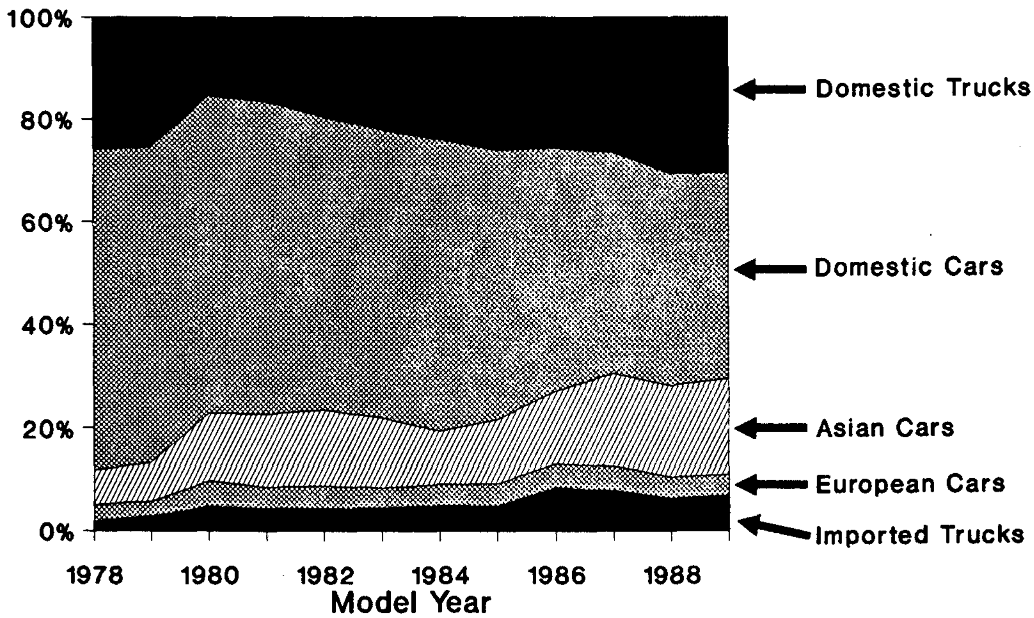

Figure 2 - Percent of CO2 per Year
by Vehicle Type & Origin

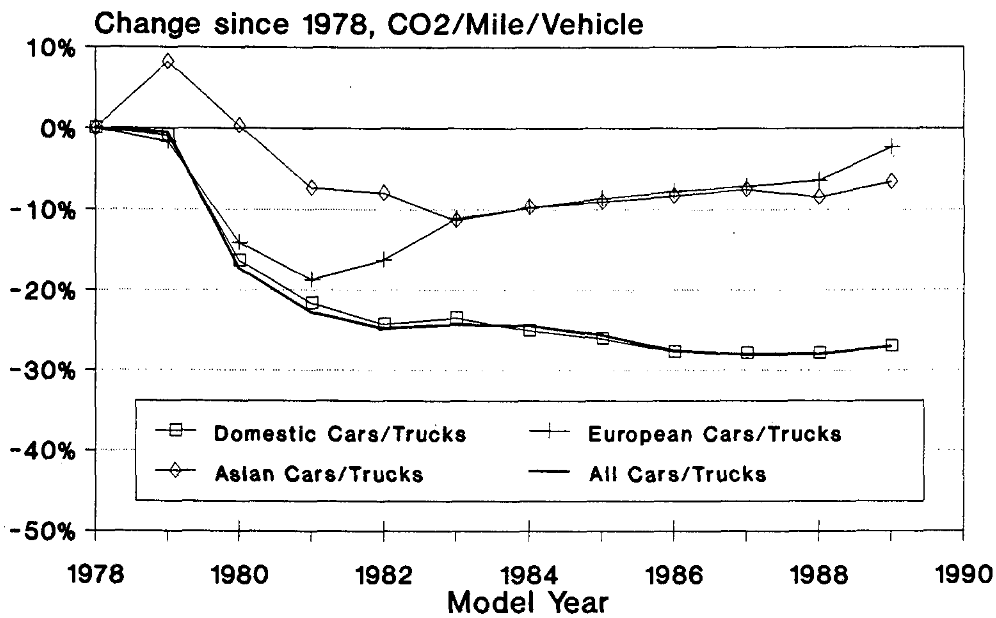

Figure 3 - Trend in CO_2, Cars & Trucks Combined

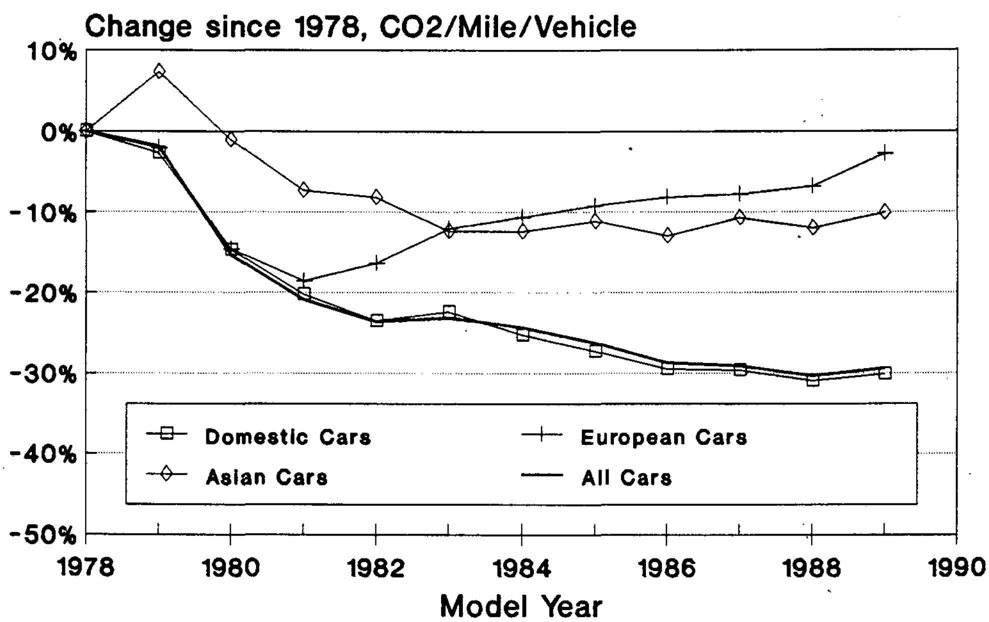

Figure 4 - Trend in CO_2, Passenger Cars

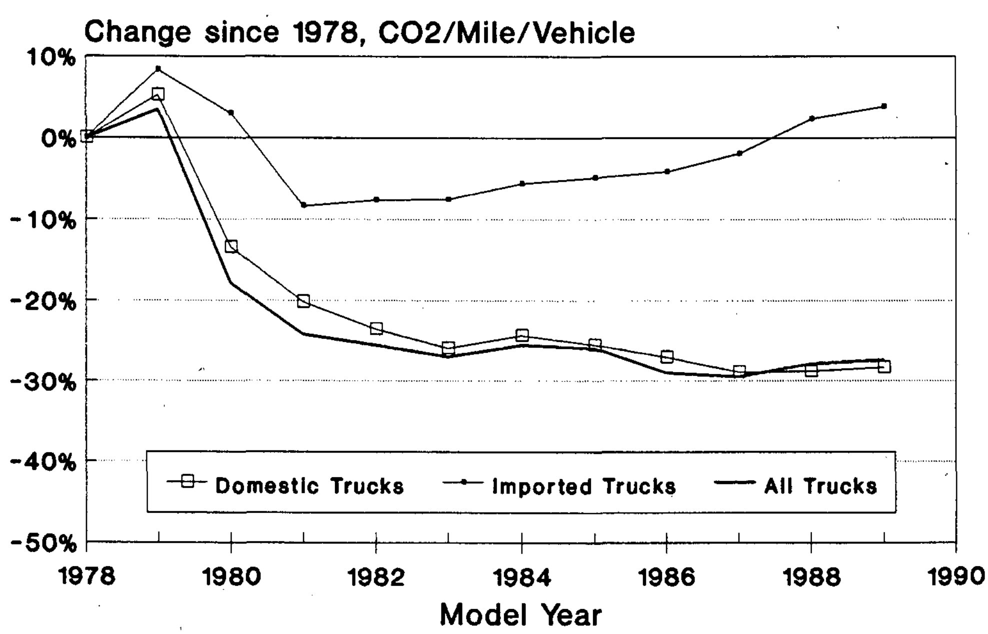

Figure 5 - Trend in CO_2, Light Trucks

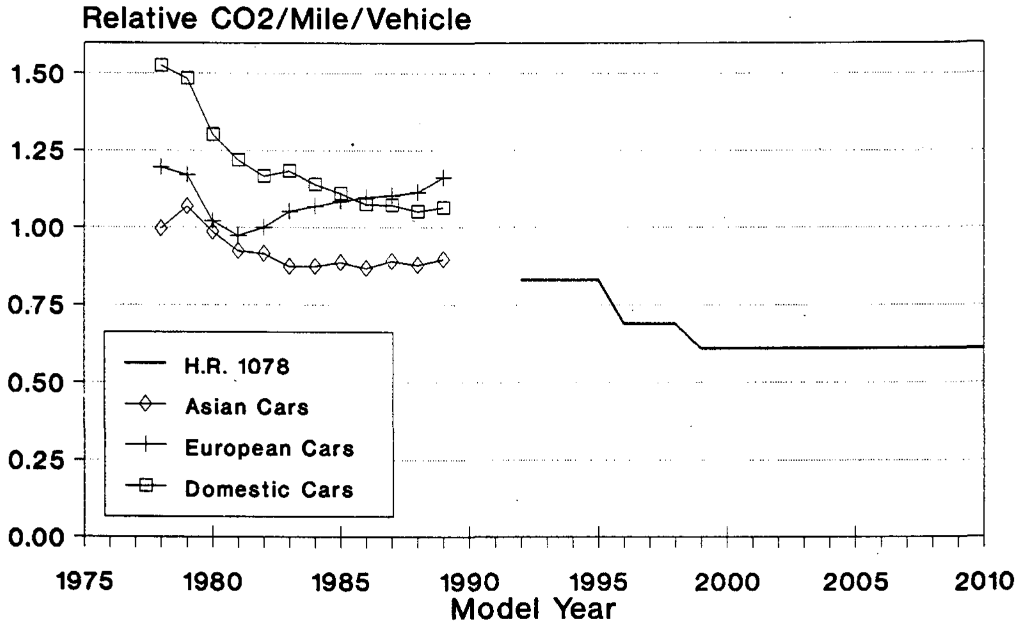

Figure 6 - CO2/Mile/Car, and H.R. 1078 Requirements (1.00 = All 1988 Cars)

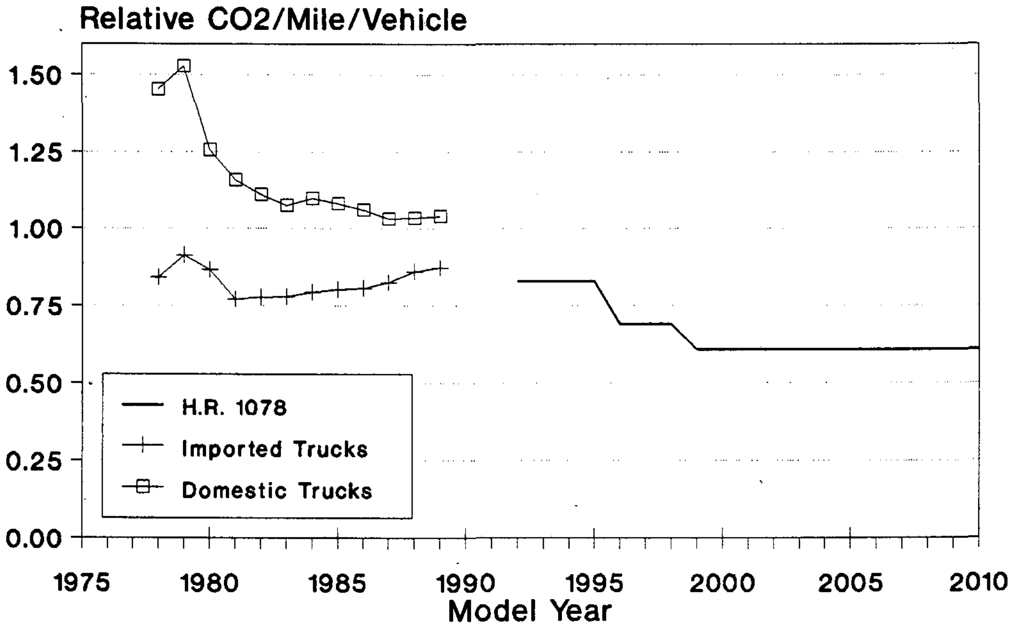

Figure 7 - CO2/Mile/Truck, and H.R. 1078 Requirements (1.00 = All 1988 Trucks)

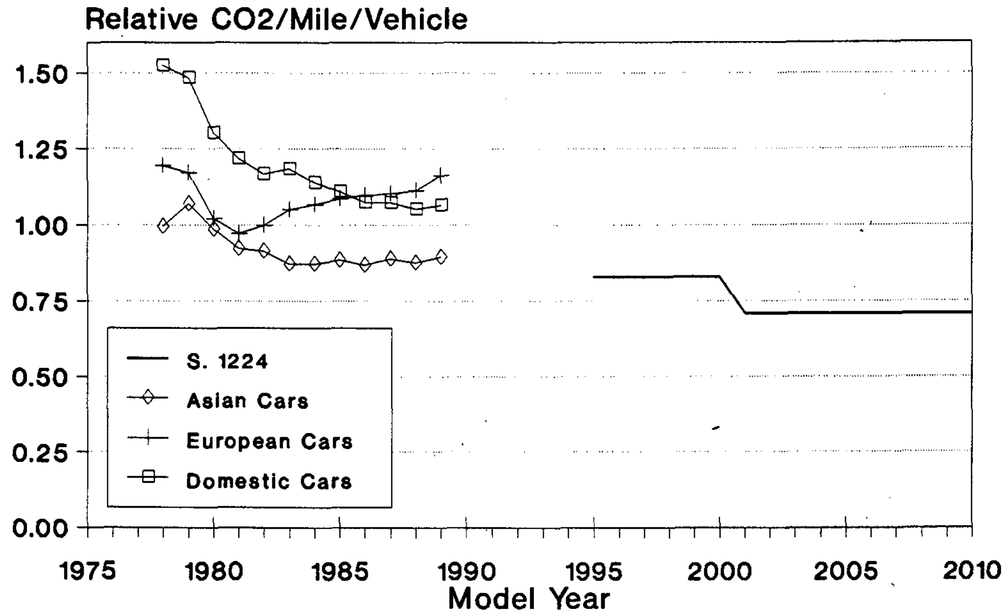

Figure 8 - CO2/Mile/Car, and S.1224 Requirements (1.00 = All 1988 Cars)

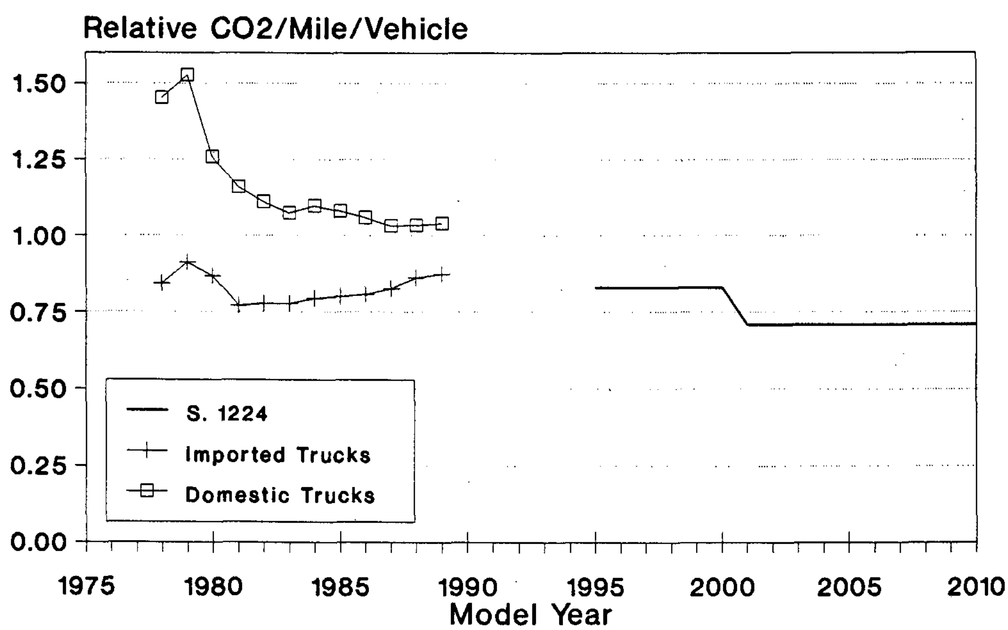

Figure 9 - CO2/Mile/Truck, and S.1224 Requirements (1.00 = All 1988 Trucks)

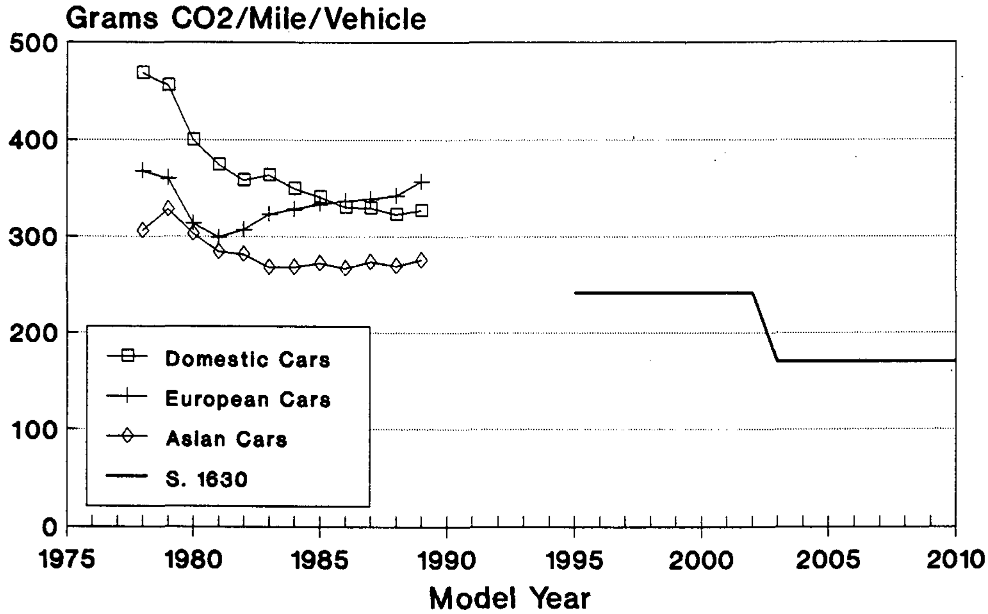

Figure 10 - CO2/Mile/Car, and S.1630 Requirements

V. <u>Banking and Selling CO_2</u>

As approaches toward regulatory controls become more flexible and market-oriented, issues such as banking and trading (selling) become of greater interest. All the options discussed in this paper are averaging approaches. It is of some interest to discuss how banking and selling could be utilized in the CO_2 control approaches discussed here. Banking is defined as being able to store up credits from performance better than required, and use them when performance does not meet required levels. Both regulatory approaches could utilize banking as part of the increased flexibility that market-based regulatory mechanisms allow. Selling is another issue. If selling of credits is to be contemplated, it would have to somehow account for the number of vehicles involved, not merely their average emissions. Modifying the regulatory measure from average grams per mile to an average gram per mile <u>per vehicle</u> basis would account for fleet size and result in a sellable unit.

Converting the current statutory penalty for falling below the fuel economy standards into dollars per vehicle gram of CO_2 yields a value of slightly less than $5.00 per vehicle gram, if the fuel economy level chosen is about 27.5 mpg. Of course the value of a credit would depend on the market, but as long as the regulatory program included the possibility of a fine for noncompliance, the value of the fine would set an upper cap on what the credits were worth.

VI. References

1. The Challenge of Global Warming, Abrahamson, Dean Edward, Editor, Island Press, Washington, DC, 1989.

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5. "Policy Options For Stabilizing Global Climate," U.S. EPA Draft Report to Congress, February 1989.

6. "The Transportation Sector and Global Warming," Parson, Edward A., OTA, May 1989.

7. "Light-Duty Automotive and Technology Trends Through 1989," Heavenrich, R. M. and J. D. Murrell, U.S. EPA, EPA/AA/CTAB/89-04, May 1989.

VII. Acknowledgment

The authors wish to express their sincere appreciation for the word processing, editing, and manuscript preparation provided by Jennifer Criss in the preparation of this report.

APPENDIX A

A GLOBAL WARMING INDEX FOR LIGHT-DUTY VEHICLES

To account for the global warming effects of pollutants other than CO_2, emission of these other pollutants can be converted into CO_2 equivalents by considering their relative global warming reactivity. Relative warming estimates for methane (CH_4) and nitrous oxide (N_2O) appear in Future Atmospheric Carbon Dioxide Scenarios and Limitation Strategies by J. A. Edmonds, et al., Noyes Publications, Park Ridge N.J., 1986.On a mass basis these were determined to be approximately 50 for CH_4 and 230 for N_2O.

Another evaluation of the global warming impact of CH_4 and N_2O is contained in "Comparing the Impacts of Different Transportation Fuels On the Greenhouse Effect," a Consultant Report to the California Energy Commission, by Acurex Corporation, Report P500-89-001, April 1989. Converting the molecule values from Table 2 of that report, values from 16 to 116 can be associated with CH_4 and 286 to 449 can be associated with N_2O for relative global warming impact.

The overall global warming index, GWI, will be a combination of the emissions from the vehicle and the relative global warming impact factors assigned to CH_4 and N_2O. In general:

$$GWI = CO_2 + a\, CH_4 + b\, N_2O$$

And, GWI = GWI(a,b) if specificied in this way will leave no ambiguity in the values chosen for the index. For this discussion, we have chosen to use GWI (a,b) = GWI (65,300).

Constructing the index then requires finding the emission data for CO_2, CH_4, and N_2O from the vehicle of interest.

The values associated with gasoline-fueled vehicles are typically 0.100 grams per mile for CH_4 from Compilation of Air Pollutant Emission Factors Volume II: Mobile Sources, AP-42, Fourth Edition, September 1985, and 0.015 grams per mile N_2O from Regulated and Unregulated Exhaust Emissions From Malfunctioning Three-Way Catalyst Gasoline Automobiles, EPA-460/3-80-004, January 1980.

The report entitled "Emissions, Fuel Economy, and Performance of Light-Duty CNG and Dual-Fuel Vehicles," by Bruetsch, R. I., EPA/AA/CTAB/88-05, June 1988, contains data taken on dual-fuel vehicles, ones that can use either gasoline or natural gas as the fuel. Using the data from that report, we can construct a GWI (65,300) from the same vehicles using different fuels.

Table A-1 illustrates the importance of the emission values in constructing GWI (65,300). Table A-1 also can be used to conclude that reliance on CO_2 only when considering global warming may produce incorrect conclusions.

Table A-1

Calculated Global Warming Index,
Gasoline and CNG-Fueled Vehicles

Vehicle	Fuel	CO_2 (gm/mi)	CH_4 (gm/mi)	N_2O* (gm/mi)	GWI(65,300)
Delta 88	Gasoline	632	0.145	0.015	646
Delta 88	CNG	464	2.456	0.015	628
Crown Victoria	Gasoline	582	0.103	0.015	593
Crown Victoria	CNG	429	3.164	0.015	639
Celebrity	Gasoline	435	0.024	0.015	441
Celebrity	CNG	354	1.478	0.015	455

* N_2O was not measured in this test program; the same nominal value is used for all entries.

In SAE Paper 890492, "Nitrous Oxide N_2O In Engines Exhaust Gases - A First Appraisal of Catalyst Impact," by M. Prigent and G. DeSoete, a summary of N_2O values is provided. The values in Table 1 of that paper range from 4.8 to 101 mg/mi N_2O, with an average value of 52 mg/mi. Using 52 mg/mi in the calculations in Table A-1 (instead of the 15 mg/mi used) would increase the GWI (65,300) values by approximately 11 units, but it would not change the ranking. Given the spread in the values summarized in Paper 890492, it would appear, however, that measured N_2O data is a desirable part of any estimates of global warming impact, and measurements of CO_2, CH_4, and N_2O from a variety of engines and fuels would be the minimum needed before a definitive ranking could be attempted.

APPENDIX B

RELATIONSHIP BETWEEN CO_2 AND FUEL ECONOMY

The carbon balance method for calculating fuel economy used by EPA computes miles per gallon as the ratio of grams of carbon per gallon of fuel to grams of carbon per mile. One version of this equation for gasoline-fueled vehicles from the Federal Register, Volume 51, No. 206, Friday, October 24, 1986, page 37,846 is:

$$MPG = \frac{2421}{0.866\ HC + 0.429\ CO + 0.273\ CO_2}$$

Where, HC, CO, and CO_2 are the grams per mile of the carbon containing exhaust constilatients. Another form of the same equation is:

$$MPG = \frac{8868}{CO_2} \frac{1}{(1 + 3.17\ HC/CO_2 + 1.57\ CO/CO_2)}$$

For today's cars, the term in parentheses represents roughly a 1 percent adjustment to the $8868/CO_2$ term. The use of HC/CO_2 and CO/CO_2 ratios different from those of today's cars results in a larger adjustment if the emission ratios are larger. Using higher emission values lowers the value of the conversion constant. The use of a constant value (8777) in this analysis, therefore, tends to overestimate the CO_2 emissions from the earlier years when the HC and CO emissions were higher. This error is at most about 5 percent. The benefits gained from using the simple inverse relationship between MPG and CO_2 are that an existing MPG database can be converted directly into a CO_2 database. The conclusions in this paper are also not sensitive to the error introduced by the use of the simplified relationship.

The MPG - CO_2 relationship is based on the tests used to determine the primary variable. For this report, we have used the EPA composite "55/45" MPG value to infer the CO_2 results. Therefore, the CO_2 values also correspond to a composite city-highway CO_2 value. Considered as an emission, this treatment of CO_2 is different from the treatment of other regulated emissions like HC, CO, and NOx, whose values and standards are determined using the "city" cycle only.

APPENDIX C : TREND IN CO2 PER VEHICLE

Model Year	55/45 MPG	Sales Millions	CO2/ Vehicle (gm/mi)	<Compared to 1988 Fleet> 55/45 MPG	Sales	CO2/ Vehicle
Domestic Passenger Cars						
1978	18.74	9.084	468.4	0.656	0.852	1.525
1979	19.26	8.761	455.8	0.674	0.822	1.484
1980	21.95	6.820	399.9	0.768	0.640	1.302
1981	23.47	6.261	373.9	0.821	0.587	1.217
1982	24.50	5.506	358.2	0.858	0.517	1.166
1983	24.14	5.682	363.5	0.845	0.533	1.183
1984	25.09	8.102	349.8	0.878	0.760	1.139
1985	25.76	7.797	340.7	0.902	0.731	1.109
1986	26.58	7.515	330.2	0.930	0.705	1.075
1987	26.63	6.702	329.6	0.932	0.629	1.073
1988	27.16	6.616	323.2	0.951	0.621	1.052
1989	26.81	6.233	327.3	0.938	0.585	1.065
European Passenger Cars						
1978	23.91	.582	367.1	0.837	0.055	1.195
1979	24.40	.520	359.7	0.854	0.049	1.171
1980	27.98	.699	313.7	0.979	0.066	1.021
1981	29.36	.525	299.0	1.028	0.049	0.973
1982	28.58	.494	307.1	1.000	0.046	1.000
1983	27.17	.441	323.0	0.951	0.041	1.051
1984	26.75	.640	328.1	0.936	0.060	1.068
1985	26.31	.666	333.5	0.921	0.062	1.086
1986	26.03	.735	337.2	0.911	0.069	1.098
1987	25.90	.745	338.8	0.907	0.070	1.103
1988	25.65	.643	342.2	0.898	0.060	1.114
1989	24.59	.593	356.9	0.861	0.056	1.162
Asian Passenger Cars						
1978	28.67	1.510	306.1	1.004	0.142	0.996
1979	26.72	1.513	328.5	0.935	0.142	1.069
1980	28.97	1.924	303.0	1.014	0.180	0.986
1981	30.93	1.948	283.8	1.083	0.183	0.924
1982	31.22	1.819	281.1	1.093	0.171	0.915
1983	32.70	1.879	268.4	1.145	0.176	0.874
1984	32.73	1.933	268.2	1.146	0.181	0.873
1985	32.23	2.328	272.3	1.128	0.218	0.886
1986	32.91	2.765	266.7	1.152	0.259	0.868
1987	32.09	3.364	273.5	1.123	0.316	0.890
1988	32.57	3.401	269.5	1.140	0.319	0.877
1989	31.88	3.461	275.3	1.116	0.325	0.896

Note : 1.000 = All 1988 Cars

Model Year	55/45 MPG	Sales Millions	CO2/ Vehicle (gm/mi)	<Compared to 1988 Fleet> 55/45 MPG	Sales	CO2/ Vehicle
Domestic Light Trucks						
1978	14.55	2.915	603.4	0.689	0.633	1.452
1979	13.83	2.616	634.8	0.655	0.568	1.527
1980	16.80	1.293	522.5	0.795	0.281	1.257
1981	18.22	1.310	481.8	0.863	0.285	1.159
1982	19.03	1.459	461.3	0.901	0.317	1.110
1983	19.64	1.806	447.0	0.930	0.392	1.076
1984	19.23	2.608	456.5	0.911	0.567	1.098
1985	19.52	2.938	449.6	0.924	0.638	1.082
1986	19.93	3.055	440.5	0.944	0.664	1.060
1987	20.45	3.160	429.2	0.968	0.687	1.033
1988	20.43	3.705	429.6	0.967	0.805	1.034
1989	20.29	3.604	432.6	0.961	0.783	1.041
Imported Light Trucks						
1978	25.07	.358	350.1	1.187	0.078	0.842
1979	23.14	.473	379.3	1.096	0.103	0.913
1980	24.34	.571	360.6	1.152	0.124	0.868
1981	27.34	.510	321.0	1.295	0.111	0.772
1982	27.14	.454	323.4	1.285	0.099	0.778
1983	27.11	.495	323.7	1.284	0.108	0.779
1984	26.56	.737	330.5	1.258	0.160	0.795
1985	26.34	.730	333.2	1.247	0.159	0.802
1986	26.15	1.296	335.7	1.238	0.282	0.808
1987	25.55	1.146	343.5	1.210	0.249	0.827
1988	24.50	.899	358.2	1.160	0.195	0.862
1989	24.16	.942	363.3	1.144	0.205	0.874

Note 1.000 = All 1988 Light Trucks

Model Year	55/45 MPG	Sales Millions	CO2/ Vehicle (gm/mi)	<Compared to 1988 Fleet> 55/45 MPG	Sales	CO2/ Vehicle
Domestic Trucks & Cars						
1978	17.51	11.999	501.2	0.678	0.786	1.475
1979	17.66	11.376	497.0	0.684	0.745	1.462
1980	20.93	8.112	419.4	0.811	0.531	1.234
1981	22.36	7.571	392.6	0.866	0.496	1.155
1982	23.11	6.965	379.8	0.895	0.456	1.117
1983	22.88	7.488	383.7	0.886	0.491	1.129
1984	23.36	10.709	375.8	0.905	0.702	1.106
1985	23.69	10.736	370.5	0.918	0.703	1.090
1986	24.24	10.570	362.1	0.939	0.692	1.065
1987	24.28	9.862	361.5	0.940	0.646	1.064
1988	24.29	10.321	361.4	0.941	0.676	1.063
1989	23.99	9.837	365.9	0.929	0.644	1.076
European Trucks & Cars						
1978	23.89	.584	367.4	0.925	0.038	1.081
1979	24.29	.529	361.4	0.941	0.035	1.063
1980	27.81	.741	315.6	1.077	0.049	0.929
1981	29.37	.569	298.8	1.137	0.037	0.879
1982	28.54	.523	307.6	1.105	0.034	0.905
1983	26.86	.456	326.7	1.040	0.030	0.961
1984	26.47	.667	331.6	1.025	0.044	0.976
1985	26.14	.685	335.8	1.012	0.045	0.988
1986	25.89	.746	339.0	1.003	0.049	0.997
1987	25.71	.760	341.4	0.996	0.050	1.004
1988	25.52	.651	343.9	0.988	0.043	1.012
1989	24.44	.603	359.1	0.947	0.040	1.056
Asian Trucks & Cars						
1978	27.92	1.865	314.4	1.081	0.122	0.925
1979	25.81	1.977	340.1	1.000	0.130	1.001
1980	27.81	2.453	315.6	1.077	0.161	0.929
1981	30.12	2.414	291.4	1.167	0.158	0.857
1982	30.34	2.244	289.3	1.175	0.147	0.851
1983	31.47	2.358	278.9	1.219	0.154	0.821
1984	30.90	2.643	284.1	1.197	0.173	0.836
1985	30.68	3.039	286.0	1.188	0.199	0.841
1986	30.45	4.049	288.2	1.179	0.265	0.848
1987	30.19	4.495	290.7	1.169	0.294	0.855
1988	30.51	4.292	287.7	1.182	0.281	0.846
1989	29.89	4.392	293.7	1.158	0.288	0.864

Note : 1.000 = All Light Trucks and Cars

Model Year	55/45 MPG	Sales Millions	CO2/ Vehicle (gm/mi)	<Compared to 1988 Fleet> 55/45 MPG	Sales	CO2/ Vehicle
All Passenger Cars						
1978	19.89	11.175	441.2	0.696	1.048	1.436
1979	20.25	10.794	433.3	0.709	1.013	1.410
1980	23.48	9.443	373.8	0.822	0.886	1.217
1981	25.13	8.733	349.3	0.880	0.819	1.137
1982	26.04	7.819	337.1	0.911	0.733	1.097
1983	25.89	8.002	339.0	0.906	0.751	1.104
1984	26.30	10.675	333.7	0.921	1.001	1.086
1985	26.96	10.791	325.5	0.944	1.012	1.060
1986	27.89	11.015	314.7	0.976	1.033	1.024
1987	28.06	10.811	312.8	0.982	1.014	1.018
1988	28.57	10.660	307.2	1.000	1.000	1.000
1989	28.17	10.286	311.5	0.986	0.965	1.014
All Light Trucks						
1978	15.24	3.273	575.7	0.722	0.711	1.385
1979	14.73	3.088	595.7	0.697	0.671	1.433
1980	18.56	1.863	472.9	0.879	0.405	1.138
1981	20.10	1.821	436.8	0.952	0.396	1.051
1982	20.48	1.914	428.6	0.970	0.416	1.031
1983	20.87	2.300	420.5	0.988	0.500	1.012
1984	20.47	3.345	428.7	0.969	0.727	1.032
1985	20.58	3.669	426.4	0.974	0.797	1.026
1986	21.45	4.350	409.3	1.016	0.945	0.985
1987	21.60	4.305	406.4	1.023	0.935	0.978
1988	21.12	4.603	415.6	1.000	1.000	1.000
1989	20.99	4.546	418.2	0.994	0.988	1.006
All Trucks & Cars						
1978	18.61	14.448	471.7	0.721	0.947	1.388
1979	18.70	13.882	469.5	0.724	0.909	1.381
1980	22.50	11.306	390.1	0.871	0.741	1.148
1981	24.09	10.554	364.4	0.933	0.691	1.072
1982	24.72	9.732	355.1	0.957	0.638	1.045
1983	24.57	10.302	357.2	0.952	0.675	1.051
1984	24.63	14.020	356.4	0.954	0.919	1.049
1985	25.00	14.460	351.1	0.968	0.947	1.033
1986	25.70	15.365	341.5	0.995	1.007	1.005
1987	25.86	15.116	339.5	1.002	0.990	0.999
1988	25.82	15.264	339.9	1.000	1.000	1.000
1989	25.50	14.832	344.2	0.988	0.972	1.013

Note : 1.000 = All Cars, All Light Trucks <u>or</u>
All Light Trucks and Cars as indicated above