# Environmental and Economic Impact Statement

## Revised Evaporative Emission Regulations for the 1978 Model Year

Mobile Source Air Pollution Control
Office of Air and Waste Management
U.S. Environmental Protection Agency

EPA United States Environmental Protection Agency

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Approved by:

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Date

## Contents

# Chapter I

## Summary

### A. Background and Description of this Action

This regulation changes the current "carbon trap" testing method for evaporative emissions set forth in the Code of Federal Regulations (40 CFR, 86.177-17) for light duty vehicles and light duty trucks. The current "carbon trap" method for measuring evaporative emissions has been found, through testing with a more accurate measurement method, to underestimate actual evaporative emissions by as much as fifteen times. The more accurate testing method is the Society of Automotive Engineers (SAE) recommended procedure for measuring evaporative emissions (SAE J171a) and involves collecting the evaporative emissions in a large sealed enclosure containing the test vehicle. The results of the 1972 EPA in-use vehicle testing program by the enclosure method showed evaporative emissions to be at a 24 g/test level, which is about 12 times the 2 g/test standard which must currently be met when testing is done by the "carbon trap" method. Thus, the amount of control thought to exist for evaporative emissions does not in actuality exist.

The final rulemaking establishes the enclosure method as the Federal evaporative emission test procedure and requires 1978 and subsequent model year vehicles to meet a 6 g/test standard. The originally proposed rulemaking called for a 2 g/test standard for 1979 and subsequent model year vehicles. Due to the need to implement the 6 g/test standard for 1978 on a very short schedule, and due to the need to examine more stringent control in greater detail, final rulemaking establishing a more stringent future standard is being considered separately from this rulemaking. The environmental impact and cost effectiveness of a more stringent standard will be dealt with in greater detail in a separate impact statement in conjunction with any separate rulemaking.

The implementation of a 6 g/test standard or a more stringent standard is currently needed since it is projected that many Air Quality Control Regions (AQCR's) will still exceed the ambient air quality standards for oxidants even as late as 1990, with the present control strategies for reducing emissions from mobile and stationary sources.

B. Environmental Impact

Evaporative emission levels, as measured during the EPA surveillance testing program, represent a large percentage of the total hydrocarbons emitted from mobile sources. The 24 g/test level represents an emission rate of 1.76 g/mile which is significantly higher than the statutory exhaust hydrocarbon emission rate of 0.41 g/mile. The final rulemaking will result in reduction of nationwide hydrocarbon emissions from all mobile sources by as much as 33% by 1985 and 46% of the year 1990. For those Air Quality Control Regions that are expected to have difficulty meeting ambient air quality standards for oxidants in 1985, a 6 g/test standard will result in reduction of hydrocarbon emissions from all sources by an average of 7.8% in that year.

The final rulemaking is not expected to have any effect on vehicle fuel consumption. Likewise, this action should not have any effect on water or solid waste pollution. While the test procedure is designed to assess potential evaporative emission-exhaust emission interactions, these interactions need not occur with proper utilization of existing control technology. Therefore, this action is not expected to have any measurable effect upon exhaust emissions.

## C. Economic Impact

### 1. Character of the Industry

The light duty vehicle and light duty truck industries are primarily comprised of General Motors Corporation, Ford Motor Company, Chrysler Corporation, American Motors Corporation, International Harvester, Toyota, Volkswagen, and Nissan (Datsun).

U.S. sales of light duty vehicles and light duty trucks in 1974 were 10.8 million vehicles sold at a total wholesale value of $34 billion.

The industry employs 3.7 million employees in manufacturing, wholesaling, and retailing of motor vehicles.

2. Impact on Consumers

It is estimated that the retail "sticker" price per vehicle will will increase an average of $7.30 for control system components required to meet a 6 g/test standard. No additional costs over the life of the vehicle due to increased fuel consumption or maintenance are expected, and therefore, the additional emissions control will cost the consumer $7.30 over the lifetime of the vehicle.

3. Impact on Industry

The major impact on the industry will be due to any decrease in sales resulting from the expected $7.30 increase in the price of vehicles. The projected sales decrease is 0.16%, assuming a price elasticity of 0.88*.

Another impact of this rulemaking on industry will be a possible change in the cost of certifying vehicles. The cost of certification may increase, remain relatively constant or decrease depending on the amount of capital expenditures required, the manpower requirements for the projected test load, and the manpower reductions due to an overall simpler test procedure. The overall test procedure is somewhat simpler

* "The Effect of Tax and Regulatory Alternatives on Car Sales and Gasoline Consumption," Prepared for CEQ by Chase Econometric Associates, May 1974, p. 4.

than that currently used and thus a reduction in manpower cost could be realized. (However, for analyses performed for this study, the manpower required was assumed to be the same.) The number of evaporative emission tests will probably be reduced by approximately 50% as a result of the implementation of evaporative-system-families as a means of selecting test vehicles and thus no increased manpower should be required to conduct the evaporative emissions tests. Regardless of these considerations, there will be a capital expenditure for purchasing the enclosures and instrumentation required for testing under the new procedure. If the expected 50% reduction in test load is realized for the current number of required tests, the cost of certification would be $455,000 (assuming no change in manpower cost) for the equipment required. If no reduction is realized, the cost would be $2.2 million over the next 5 years for required equipment and increased manpower costs. In either case, it will cost manufacturers only a small fraction of a dollar per vehicle.

4. Government Costs

The cost to the government for the motor vehicle certification program is expected to increase. Capital investment for additional equipment, instrumentation and facility modification is estimated at $400,000 (assuming no change in manpower costs). If the expected 50% reduction in test load is not realized the capital investment is estimated to be $200,000 and the cost of additional personnel to conduct tests is estimated to be $400,000 over a 5 year period. The capital cost required is small when compared to the $19 million capital investment already made for the EPA test facility used to conduct Federal certification testing.

5. Cost Effectiveness

The cost effectiveness of this rulemaking is estimated to be $50 per ton of hydrocarbon removed. This action is much more cost effective than reducing exhaust hydrocarbons to the statutory level of 0.41 g/mile which has a cost effectiveness of between $500 and $1400 per ton of hydrocarbon removed.

D. Alternative Actions

The principle alternative actions considered were (I) Take no action, (II) Set a 6 g/test standard for 1978 and subsequent model year vehicles as measured by the Federal enclosure test method, and (III) Set a 2 g/test standard for 1978 and subsequent model year vehicles as measured by the Federal enclosure test method. Alternative action I (no action) was rejected because the current test procedure gives unrealistically low test results, and thus, evaporative emissions from current vehicles are significantly greater than the current Federal exhaust hydrocarbon emission standard and grossly exceed the level intended by the present Federal evaporative emission standard. Alternative III (2 g/test standard for 1978) was rejected due to insufficient lead time to meet a 2 g/test level by 1978. This alternative was, therefore, not considered in the environmental and cost analyses. Other alternatives considered were the control of stationary sources of hydrocarbon emissions and the further control of exhaust hydrocarbons from mobile sources. Due to the nature of stationary sources and the infeasibility of further exhaust hydrocarbon control from mobile sources over what is currently planned, these alternatives were rejected and not treated in any detail.

# Chapter II

## Introduction

### A. Need for Control, Background and Description of This Action

In many geographic regions a large portion of hydrocarbons (HC), carbon monoxide (CO), and nitrogen oxides (NOx) present in the air are attributable to motor vehicle emissions. The Congress, in recognition of the air pollution problem, passed the Clean Air Act which provides for a national air pollution program to monitor and control emissions from new motor vehicles and engines.

Section 202(a) of the Clean Air Act, 42 U.S.C. 1957-1(a), provides that the Administrator shall prescribe standards for motor vehicle emissions if such emissions cause or contribute to air pollution which endangers the public health or welfare. The Administrator can require testing of new motor vehicles to determine compliance with applicable standards under Section 206 and the general power to promulgate regulations is granted in Section 301.

The need for further control of evaporative hydrocarbon emissions is based on the determination that the present and planned regulations for control of mobile and stationary sources of hydrocarbons are insufficient to bring many Air Quality Control Regions (AQCR's) into compliance with the ambient air quality standards for oxidants. This determination was based upon an analysis which used the best available inputs of vehicle mix, growth rates, emission factors and current ambient air quality data. In particular, Los Angeles, Sacramento, San Diego, San Francisco, San Joquin Valley, Corpus Cristi, Houston, Phoenix-Tucson, Denver, and the New Jersey portions of the New York AQCR will still exceed oxidant standards in 1990.

The health effects of photochemical oxidants have been considered and described in previous publications.* Photochemical oxidants are created during photochemical reactions involving hydrocarbons and are thus controlled indirectly by controlling hydrocarbons. Ambient air quality standards have been set, based on those considerations, at levels which assure adequate public protection from the regulated pollutants. Given that ambient air quality standards have been set, based on those considerations, at levels which assure adequate public protection from the regulated pollutants, and given that ambient air quality standards will be exceeded in many air quality control regions as discussed earlier, further reductions in HC emissions are necessary.

Fuel evaporative hydrocarbon emissions have been studied and measured since 1958. Federal control of evaporative emissions was first proposed in the Federal Register on February 4, 1967 (32 FR, pp. 2448-50) to become effective for the 1969 model year. At that time a novel and

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*Air Quality Criteria Documents, Nos. AP-62, AP-63, AP-64, and AP-84.

relatively untried measurement procedure was proposed, which collects the evaporative emissions in a large sealed enclosure containing the test vehicle. However, when final rule making was published in the Federal Register on June 4, 1968 (33 FR, pp. 8304-24), the vehicle enclosure measurement procedure was abandoned in favor of a better known procedure, called the carbon trap method, which utilizes the adsorption of hydrocarbon on activated carbon. The activated carbon, encased in a metal canister, is weighed before and after the test to determine the mass of hydrocarbon adsorbed.

The evaporative emission test measures the evaporative hydrocarbons emitted by the vehicle during daily temperature changes, vehicle operation, and periods of hot engine soaking. This is accomplished during a three part test. The first part consists of artificially heating the fuel tank during a one hour period to simulate the normal rise in tank temperature resulting from normal daily ambient temperature increases. The second part of the test measures the losses during vehicle operation over a 7.5 mile trip. The third portion of the test consists of measuring the evaporative losses during the first hour after vehicle operation, when the engine is still hot.

Using this test sequence, an emission standard was set at 6 g/test for the 1971 model year as measured by the carbon trap method. The evaporative emission standard was then reduced to 2 g/test for 1972 and subsequent model years.

Over the intervening years since 1967 the vehicle enclosure method has been evaluated by several organizations, is considered to be "a superior technique, a versatile tool" (SAE paper 680125) compared to the "carbon trap" method, and has been developed into an SAE recommended practice (J171a).* This procedure was further modified to produce the Federal enclosure test method being adopted by this rulemaking.

While certification tests by the carbon trap method indicate that evaporative emissions from 1971 and later model year vehicles are substantially below the current 2 g/test standard, tests conducted according to the SAE vehicle enclosure method indicate that evaporative emissions from controlled vehicles are substantially above the standards. Average emissions from the 1972 EPA surveillance test program of "controlled" in-use 1972 model year vehicles are about 24 g/test by the SAE vehicle enclosure method, more than 12 times the current 2 g/test standard established for the carbon trap method. When this emission level is converted to an urban gram per mile equivalent, the resultant level is about 1.76 g/mile as compared to the current Federal exhaust emission standard of 1.5 g/mile and the statutory goal of 0.41 g/mile. It is clear that the carbon trap method does not accurately measure evaporative emissions and thus the control of hydrocarbons thought to exist due to a 2 g/test standard using the "carbon trap" method does not exist.

*"Measurement of Fuel Evaporative Emissions from Gasoline Powered Passenger Cars and Light Trucks Using the Enclosure Technique - SAE J171a", published in the SAE Handbook, 1973.

In April, 1975, the State of California requested a waiver of Federal preemption under Section 209(b) of the Clean Air Act, to enable California to enforce a light duty vehicle and light duty truck evaporative emission standard for the 1977 and subsequent model years of 6 g/test, as measured by the SAE vehicle enclosure method. The resultant waiver decision, published in the Federal Register on July 18, 1975 denied the waiver for 1977, but granted it for 1978 and subsequent model years subject to review for continuing satisfaction of the statutory requirements at such time as an EPA standard is promulgated. It also committed EPA to make all reasonable efforts to accelerate the previously announced schedule and establish a Federal evaporative emission regulation for 1978 instead of 1979.

The final regulations require more stringent control of evaporative emissions from light duty vehicles and light duty trucks through revision of the evaporative emission test procedure and emission standards. The revision of the evaporative test procedure consists basically of replacing the carbon trap method of collecting the evaporative emissions with the more effective vehicle enclosure method. The Federal enclosure method for measuring the evaporative emissions is basically a revision of the SAE J171a procedure based on developmental work undertaken at EPA.

The proposed regulations were published in the Federal Register on January 13, 1976. The proposed standards were

6 g/test for 1978 MY vehicles and 2 g/test for 1979 and subsequent MY vehicles. To insure sufficient lead-time for implementation of the 6 gram standard in 1978, the test procedures and 6 gram standard are being promulgated at this time. Promulgation of a more stringent future standard is presently being considered by the Agency.

It should be noted that the Federal enclosure test method and standard for 1978 continue to require that light duty trucks be controlled to the same level as light duty vehicles, since the already developed evaporative emission control technology can be as effectively applied to light duty trucks as to light duty vehicles.

B. Alternative Actions Considered

Alternative actions to the final rulemaking fall into three categories: (1) control hydrocarbons from other than mobile sources, (2) additional control of exhaust hydrocarbon emissions from mobile sources and (3) take alternative actions for the control of evaporative hydrocarbon emissions from light duty vehicles and light duty trucks.

The division of emission sources into stationary and mobile categories by the Clean Air Act was not made as a function of the types of pollutants that they emit. Although excess pollutant emission of carbon monoxide (CO) is almost exclusively caused by mobile sources. the other currently regulated emissions from mobile sources (HC, NOx) are also emitted in substantial quantity by stationary sources. The division of sources into stationary and mobile categories appears to have been a function of a fundamental difference in the perception of how national strategies for their control could best be designed and executed:

°Stationary sources tend to be individually unique, tend to exist for a long period of time if not indefinitely, tend in each case to require individualized control plans, and in the case of existing sources are primarily subject to State or local regulation. While new sources are in some cases subject to national regulation, such regulation is a long term control mechanism rather than a solution to the short term air quality problem;

°Mobile sources, although vast in terms of individual numbers, tend to fall into relatively small generalized categories; tend to have far shorter life-spans (prior to being replaced with new equipment) than do stationary sources; and tend, because of the standardized mass production nature of creating them, to be more amenable to national (rather than local) control,at least insofar as their design and production is concerned.

Because of the nature of the national control strategy for stationary sources, the future control of stationary sources as an alternative is not given further consideration in this document.

The second category of alternative actions pertains to the additional control of exhaust hydrocarbon emissions from mobile sources. As was stated earlier, there are many regions which will not be able to meet ambient air quality standards by 1990 even if currently planned control of motorcycle, light duty truck, and heavy duty vehicle exhaust emissions and statutory standards for light duty vehicle exhaust emissions are implemented. Control of exhaust emissions from these sources beyond levels now planned is not considered to be technologically feasible at this time. However, additional control of evaporative hydrocarbon emissions from light duty vehicles and light duty trucks is feasible.

Thus, the alternative actions that will be considered will only deal with those alternatives directly pertaining to evaporative control, because of the nature of the national control strategy for stationary sources and the infeasibility at this time of proposing more stringent control of other mobile sources of hydrocarbon emissions. The alternative actions that will be considered therefore are as follows:

| | |
|---|---|
| Alternative Action I - | No Action. No change in the present standard or test method. |
| Alternative Action II - | Set a 6 g/test standard for 1978 and subsequent model years as measured by the Federal enclosure method. |
| Alternative Action III- | Set a 2 g/test standard for 1978 subsequent model years as measured by the Federal enclosure method. |

Alternative Action III (2 g/test standard in 1978) is not feasible due to insufficient lead time. It is a desirable goal, however, due to the potential for substantial additional reductions. The environmental and inflationary impact of a 2 g/test standard for 1978 will not be considered in this document due to the infeasibility of such an action. The impact of any further more stringent control of evaporative emissions for later than 1978 model years will be dealt with separately in conjunction with such action.

## C. Structure of Report

This report is an analysis of the economic and environmental impact of setting an evaporative emission standard for 1978 and subsequent model years using the enclosure test method. Chapter

III of this report will set the ground work for these analyses by describing the Light Duty Vehicle (LDV) and Light Duty Truck (LDT) industries with respect to production and employment, etc. In addition current and projected vehicle populations and a description of vehicle usage will be presented.

Chapter IV will discuss the primary and secondary impacts of the alternative actions on environmental quality.

In Chapter V, the analysis of the costs to the consumer, industry and government will be discussed. The predicted costs will be made to reflect an average cost to all consumers and industry, and as such will ignore the variability in costs to individual consumers resulting from the variety of emission control systems capable of meeting the standard, and the costs of the equipment in that system. The costs to consumers may also vary depending on a manufacturer's perception of the market force and the discretionary power he has in setting prices of vehicles.

The cost effectiveness of the final rulemaking will be discussed in Chapter VI. The cost effectiveness of this action and the cost effectiveness of alternative actions for the control of hydrocarbon emissions will be compared. Cost effectiveness will be expressed in terms of dollars required to control a ton of hydrocarbons.

Chapter VII will discuss the impact of the alternative actions on the irreversible or irretrievable commitment of our natural resources. Along with this discussion, will be a discussion of the trade-offs between short-term gains and long-term losses, or vice versa, and a rationale for the timing of this proposed action.

Comments on the draft impact statement will be summarized and discussed in Chapter VIII.

# Chapter III

## Description of LDV, LDT Industry

### A. Definition of Product

A Light Duty Vehicle (LDV) is currently defined as a passenger car or passenger car derivative capable of seating 12 passengers or less. Light Duty Vehicles are currently required to pass a 2 g/test evaporative emission standard as measured by the carbon trap method, as well as exhaust emissions standards of 1.5 g/mi HC, 15 g/mi CO, and 3.1 g/mi NOx.

The definition of Light Duty Truck (LDT), proposed in another action by EPA[1], is any motor vehicle rated at 8,500 pounds Gross Vehicle Weight (GVW) or less and under 6,000 pounds vehicle curb weight which is: a) designed primarily for purposes of transportation of property or is a derivative of such a vehicle, or b) designed primarily for transportation of persons having a capacity of more than 12 persons, or c) available with special features enabling off-street or off-highway operation and use.

Currently, trucks between 6,000 and 8,500 pounds GVW are

1. Federal Register, February 12, 1976
(Vol. 41 - No. 30, p. 279)

classified as heavy duty vehicles and as such they are not required to be tested for evaporative emissions. The adoption of the new definition will be independent of these rules. If the light duty truck proposal is not adopted, then light duty trucks would retain their current definition (0-6,000 lbs. GVW) and the sales figures for light duty trucks presented in this section would be about 25% lower.

The LDV and LDT industries produce a wide variety of vehicles consisting of many significant variations in vehicle design and size and many engine configurations, engine sizes, fuel tank sizes, etc. EPA Surveillance data on light duty vehicles did not show any statistically significant correlation between evaporative emissions and the fuel tank or engine size. Thus, the variations in product configuration should pose no special problems for the industry in complying with further evaporative regulations.

## B. Structure of the Industry (Production and Marketing)

U.S. manufacture of light duty vehicles is almost entirely done by the four major motor vehicle manufacturers: General Motors, Ford Motor Company, Chrysler Corp., and American Motors Corp. However, a sizable percentage of new LDV sales is from imported vehicles. In 1974, 802,370 cars were built in Canada and exported for sale in the U.S. Imports accounted for roughly 16% of new car sales in the U.S. The major foreign importers are Volkswagen, Toyota and Nissan (Datsun).

The manufacture of light duty trucks sold in the U.S. is primarily accomplished by the major domestic passenger car producers. General Motors Corporation (Chevrolet and GMC divisions), Ford Motor Company and Chrysler Corporation (Dodge Truck division) all have separate truck divisions which produce light duty as well as heavy duty trucks. American Motors Corporation operates the Jeep division which manufactures light duty trucks.

The other major domestic manufacturer of LDTs is the International Harvester Corporation (IHC). International does not produce light duty passenger vehicles but does produce a line of light and heavy duty trucks.

Some LDTs sold in the U.S. are imported. The majority of U.S. imports of trucks come from the Canadian plants operated by U.S. domestic producers. Some imports, primarily light pick-up trucks, under 4,000 pounds GVW, come from Japanese producers. The major importers are Nissan (Datsun), Toyota, Isuzu, and Toyo Kogyo. Both Toyota and the British Leyland Company import utility vehicles under 6,000 lbs. GVW. Imports account for about 5% of all 1974 factory sales of trucks with a GVW less than 10,000 pounds.

Table III-1 shows unit factory sales for light duty vehicles and light duty trucks from U.S. plants. Most data available on light duty trucks are presented in two categories, based on GVW.

There is a 0-6,000 pound and a 6,001-10,000 pound category. Since the proposed definition of light duty trucks includes only trucks up to 8,500 pounds GVW, some adjustment to the 6,001-10,000 category was necessary for this analysis. 1974 industry production data available to EPA indicates that only five percent of all trucks with GVWs less than 10,000 pounds have GVWs of more than 8,500 pounds. This five percent figure is used in Table III-1 and throughout this analysis to adjust production data to fit the proposed LDT definition.

Table III-2 shows new car and truck registrations for 1973 and 1974. These figures represent the numbers of both domestic and imported vehicles bought by U.S. consumers in those years.

Table III-3 is a breakdown of market sales by manufacturer for 1974 light duty vehicles. Also included is the percent of the passenger car market for each manufacturer. Table III-4 gives similar information for the light duty truck industry. It should be noted that Table III-4 gives market shares for 0-10,000 lbs. GVW truck sales. Data indicating the portion of sales for 0-8,500 lbs. GVW trucks for each manufacturer was not available and the assumption that 5% of sales would be over 8500 lbs. GVW is not valid for all manufacturers.

U.S. light duty vehicle and light duty truck manufacturers operate with a fair degree of vertical integration. As is

Table III-1

Light Duty Vehicle and Light Duty Truck

Factory Sales from U.S. Plants[1]

| Type of Vehicle | 1974[2] | 1973 | 1972 | 1971 | 1970 | 1969 |
|---|---|---|---|---|---|---|
| Light Duty Vehicle | 7,331,946 | 9,657,647 | 8,823,938 | 8,584,592 | 6,546,817 | 8,223,715 |
| Light Duty Truck redefined class (0-8,500 lb. GVW) | 2,154,892 | 2,372,269 | 1,899,204 | 1,598,785 | 1,284,251 | 1,450,011 |
| LDV plus redefined LDT classes | 9,486,838 | 12,029,916 | 10,723,142 | 10,183,377 | 7,831,068 | 9,673,726 |

Source: Motor Vehicle Manufacturers Association of the United States, Inc.

1) includes those vehicle produced in U.S. that are exported

2) Data from Automotive News Almanac, 1975

Table III-2

New vehicle Registrations[1]

| Source | New Car Registrations '74 | '73 |
|---|---|---|
| LDV | 8,701,094 | 11,350,995 |
| LDT[2] | 2,143,198 | 2,431,454 |
| Total | 10,844,292 | 13,782,449 |

Source: Automotive News Almanac, 1975

1) Includes imports

2) Redefined Light Duty Truck Class (0-8,500 lb. GVW)

Table III-3

Market Sales of Light Duty Vehicles
by Manufacturer for 1974

| Manufacturer | No. of Units Produced | % of Passenger Car Market |
|---|---|---|
| Chevrolet | 1,973,706 | 22.68 |
| Pontiac | 504,081 | 5.79 |
| Oldsmobile | 519,082 | 5.97 |
| Buick | 428,194 | 4.92 |
| Cadillac | 219,993 | 2.53 |
| GM Total | 3,645,056 | 41.89 |
| Ford | 1,756,811 | 20.19 |
| Lincoln | 84,693 | .97 |
| Mercury | 330,513 | 3.80 |
| Ford Total | 2,172,017 | 24.96 |
| Plymouth | 597,276 | 6.86 |
| Dodge | 462,872 | 5.32 |
| Chrysler | 120,054 | 1.38 |
| Chrysler Total | 1,180,202 | 13.56 |
| American Motors Corp. | 329,431 | 3.79 |
| Miscellaneous Domestic | 5,240 | 0.06 |
| Imports | 1,369,148 | 15.74 |
| Total | 8,701,094 | 100% |

Source: Automotive News Almanac, 1975

Table III-4

Market Sales of Light Duty Trucks[1]
by Manufacturer for 1974

| Manufacturer | No. of U.S. Truck Sales | % of Light Truck Market |
|---|---|---|
| Chevrolet | 803,864 | 35.63 |
| GMC | 142,055 | 6.30 |
| Ford | 760,356 | 33.70 |
| Chrysler | 262,840 | 11.65 |
| AMC/Jeep | 96,835 | 4.29 |
| IHC | 73,656 | 3.26 |
| Other Manufacturers[2] | 116,392 | 5.16 |
| Total | 2,255,998 | 100% |

Source Automotive News Almanac, 1975

1 Light Truck defined as 0-10,000 lb GVW

2 Includes imports

typical of many capital intensive industries, the manufacturer seeks to assure himself of some control over the quality and availability of the final product. Thus, the major manufacturing companies have acquired subsidiaries or started divisions to produce many of the parts used in the manufacture of their cars and trucks. None, however, build their vehicles without buying some equipment from independent vendors.

The vertical integration typical of passenger car and truck manufacturers extends beyond the production of the vehicle into its sale. The manufacturers establish franchised dealerships to handle retail trade and servicing of their products. Most also produce and sell the parts and accessories required to service their vehicles. Many of the truck dealerships are coupled with the passenger car dealerships. As of January, 1975, there was a total of 24,980 passenger car dealerships and 24,851 truck dealerships. The total truck dealerships include dealerships for heavy duty as well as light duty trucks, and accounts for those dealerships operating jointly with passenger car sales offices.

Table III-5 provides a breakdown of all light duty vehicle dealerships by manufacturer and Table III-6 provides this information for light duty truck dealerships. The "Others" category for light duty trucks includes dealerships of manufacturers that produce only heavy duty vehicles, and also 3,392 dealerships for Plymouth which introduced the 4-wheel drive Trail Duster (an off-road utility vehicle) in 1974.

Table III-5

Passenger Car Dealerships by Manufacturer

| Manufacturer | Total Franchises | Dealerships as of Jan. 1, 1975 | Unit Sales Per Outlet 1974 | Unit Sales Per Outlet 1973 |
|---|---|---|---|---|
| American Motors | 1,862 | 1,862 | 176 | 205 |
| Chrysler Corp. | 9,878 | 5,142 | | |
| Chrysler | 3,360 | | 36 | 51 |
| Dodge | 3,126 | | 149 | 186 |
| Plymouth | 3,392 | | 176 | 216 |
| Ford Motor Co. | 10,089 | 6,706 | | |
| Ford | 5,620 | | 318 | 380 |
| Lincoln | 1,565 | | 56 | 76 |
| Mercury | 2,904 | | 117 | 145 |
| General Motors Corp. | 17,320 | 11,860 | | |
| Buick | 3,040 | | 141 | 224 |
| Cadillac | 1,620 | | 138 | 178 |
| Chevrolet | 6,060 | | 332 | 408 |
| Oldsmobile | 3,325 | | 158 | 241 |
| Pontiac | 3,375 | | 151 | 244 |
| Totals | 39,149 | 25,570 | | |
| Minus Intercorporate Duals | | 590 | | |
| Adjusted Total | | 24,980 | | |

Source: Automotive News Almanac, 1975

Table III-6

Truck Dealerships by Manufacturer

| Manufacturer | Dealerships as of January 1975 | Unit Sales Per Outlet 1974 | 1973 |
|---|---|---|---|
| Ford | 5,679 | 156 | 175 |
| Chevrolet | 6,055 | 146 | 163 |
| GMC | 2,789 | 70 | 76 |
| Dodge | 3,249 | 91 | 95 |
| IHC | 2,321 | 70 | 75 |
| AMC/Jeep | 1,451 | 67 | 47 |
| Others | 4,854 | - | - |
| Total | 26,398 | | |
| less: Adjustment For Multiple Franchises | 1,547 | | |
| Total | 24,851 | | |

Source: Automotive News Almanac: 1975

## C. Sales and Revenues

Passenger car sales from domestic manufacturers for 1974 were 7.33 million vehicles at a total wholesale value of $21.8 billion. For 1973, 9.66 million vehicles were sold at a wholesale value of $26.2 billion. The light duty truck industry (0-8,500 lbs. GVW) had 2.15 million sales at a value of $7.98 billion in 1974 and 2.37 million sales at a value of $7.60 billion in 1973.

## D. Employment

It is estimated that 3,661,549 workers are employed in manufacturing, wholesaling and retailing of motor vehicles (passenger cars, trucks, and busses) with a total $25.5 billion dollars in wages paid to those employees. Accurate employment figures for the separate manufacturing, wholesaling and retailing of light duty trucks or light duty vehicles are difficult to find. Most employment data are aggregated for all producers of all classes of cars and trucks since some production facilities manufacture light, medium, and heavy trucks. Statistics show that approximately 31,400 workers were employed in 1972 by U.S. manufacturers of trucks. The annual payroll of these workers totalled $250.25 million dollars. Much of this employment is centered in California, Michigan, Ohio, New York, Indiana, Illinois and Missouri.

# Chapter IV

## Environmental Impact

### A. Primary Impact

This section will describe the expected environmental impact of the establishment of an evaporative emission standard in 1978 using the Federal enclosure test method. The alternative actions considered in this Chapter, Chapter V and Chapter VI, are as follows:

Alternative Action I: No action.

Alternative Action II: A 6 g/test standard for 1978 and subsequent model years as measured by the Federal enclosure test procedure.

In addition, the primary impacts of other reference control strategies will be presented in order to show the relative effectiveness of the final rulemaking in the reduction of hydrocarbon emissions. These strategies include reduction of light duty vehicle exhaust standards to statutory levels and an inspection maintenance program.

1. Current and Projected Emission Factors

In order to evaluate the effect of alternative actions on ambient air quality, the rate of emission of hydrocarbons from different sources including evaporation must be known as a function of vehicle age.

Tables IV-1 and IV-2 give the evaporative hydrocarbon emission rates for light duty vehicles and light duty trucks respectively. Past emission rates for light duty vehicles were obtained from surveillance testing of 1957 through 1972 model year vehicles. 1971 and 1972 vehicles were controlled for evaporative emissions under the current "carbon trap" certification test method. If no action is taken to change the test method used to measure evaporative emissions, then similar emissions levels to those measured in 1972 could be expected from future vehicles. This same argument would also apply to light duty trucks. Future evaporative emissions rates are also shown for a 6 g/test standard. This standard assumes that the emissions would be comprised of 1 g/test from the diurnal portion of the test, with the rest being contributed during the hot soak portion of the evaporative emission test.

In order to estimate the environmental impact of a 6 g/test standard for the 1978 model year, the emission factors presented for evaporative emissions and also emission factors for light

Table IV-1

Evaporative HC Emission Factors
for Light Duty Vehicles by Model Year

| | Evaporative HC Emission Factors | | | |
|---|---|---|---|---|
| | By Source | | Composite Emissions[a] | |
| Model Year(s) | Diurnal (g/day) | Hot Soak (g/trip) | g/day | g/mi |
| pre 1970 | 26.0 | 14.7 | 74.5 | 2.53 |
| 1970 (Calif.) | 16.3 | 10.9 | 52.3 | 1.78 |
| 1970 (non-Calif.) | 26.0 | 14.7 | 74.5 | 2.53 |
| 1971 | 16.3 | 10.9 | 52.3 | 1.78 |
| 1972-77 | 12.1 | 12.0 | 51.7 | 1.76 |
| 6 g/test std. | 1.0 | 5.0 | 17.5 | 0.60 |

Source: Supplement No. 5 for Compilation of Air Pollutant Emission Factors, AP-42.

a.) Gram per day values are hot soak emissions times the average number of trips per day plus diurnal emissions. Nationwide data from the Department of Transportation and Automobile Manufacturers Association indicate that the average vehicle is used 3.3 trips per day. Gram/mile values were determined by dividing average g/day by the average nationwide travel per vehicle of 29.4 mi/day.

Table IV-2

Evaporative HC Emission Factors
for Light Duty Trucks by Model Year

| Model Year(s) | HC Emission Factor[1] (g/mi) |
|---|---|
| pre 1970 | 3.6 |
| 1970-1977 | 3.1 |
| 6 g/test Standard | .60 |

Source: Supplement No. 5 for Compilation of Air Pollutant Emission Factors, AP-42.

1) Gram per mile values are based on 3.3 hot soaks per day and 29.4 miles travelled per day.

duty vehicle exhaust, light duty truck exhaust, heavy duty vehicles evaporative plus exhaust, crank case emissions and motorcycle hydrocarbon emissions must be coupled with the data indicating the vehicle miles travelled during a year's time in order to estimate the tons of hydrocarbons emitted per year from each of these sources. For the computation of hydrocarbon emissions from various sources the following assumptions were made:

a. Light Duty Vehicles - The 1975 interim standard of 1.5 g/mi for exhaust hydrocarbons is in effect until 1977. In 1978 light duty vehicles will be assumed to meet the statutory exhaust hydrocarbon emission standard of 0.41 g/mi. Evaporative emission rates will be those shown in Table IV-1.

b. Light Duty Trucks - In the analysis, light duty trucks are defined as all trucks with gross vehicle weight below 8500 lbs. Until 1978 trucks below 6000 lbs. are assumed to be regulated at a level of 2.0 g/mi of exhaust hydrocarbons. Prior to 1978 trucks between 6000 and 8500 lbs. are assumed to be regulated as heavy duty vehicles at an exhaust HC levels of 5.6 g/mile. In 1978 and subsequent years, all light duty trucks are assumed to be regulated to an exhaust HC standard of 1.7 g/mi. These assumed standards are expected to be promulgated by late 1976. Evaporative HC emissions from LDT's are as shown in Table IV-2.

c. Heavy Duty Vehicles - In this analysis, heavy duty vehicles are defined as all trucks with a gross vehicle weight above 8500 lbs. It is assumed that heavy duty gasoline trucks are regulated at a level of 19.7 g/mi between 1970 and 1973, 12.4 g/mi between 1974 and 1978, and 3.2 g/mi in 1979 and subsequent years. It is assumed that heavy duty diesel trucks are regulated at a level of 4.5 g/mi starting in 1974.

d. Motorcycles - For this analysis, motorcycles are not considered, since, with the implementation of regulations to control exhaust emissions from motorcycles beginning in 1978, the inclusion of motorcycles would not have an appreciable impact on the projections made.

If the exhaust hydrocarbon emission standards that are assumed to be in effect in 1978 are not put into effect at that time, then exhaust hydrocarbon emissions will be higher than shown in the analyses made.

2. <u>Vehicle Population and Vehicle Usage</u>

In order to estimate the amount of a pollutant released to the atmosphere, it is necessary to know how many vehicles are in use and what proportion of different age vehicles are in that population. It is also necessary to know how much mileage is accumulated by the different segments of the vehicle population.

Table IV-3 gives vehicle registrations for the past 10 years. Table IV-4 and IV-5 give the fraction of annual travel by model year for light duty vehicles and light duty trucks respectively. By coupling these fractions with the overall annual mileage (urban plus rural) and the emission rates from different age vehicles, one can predict the total amount of pollutant emitted to the atmosphere in a given year. Similar data can be used to determine the contribution of exhaust HC emissions and other mobile HC sources.

Mileage accumulation rates nationwide and for the five Air Quality Control Regions evaluated in this chapter are given in Tables IV-6 and IV-7 for light duty vehicles and light duty trucks respectively.

Table IV-3

Passenger Car and Truck Registration
For the Last 10 Years*

| Year | Passenger Cars | Trucks[1] |
|---|---|---|
| 1974 | 105,290,000 | 25,030,000 |
| 1973 | 101,762,477 | 23,232,872 |
| 1972 | 96,980,314 | 21,238,922 |
| 1971 | 92,754,061 | 19,837,063 |
| 1970 | 89,230,567 | 18,767,294 |
| 1969 | 86,852,275 | 17,882,129 |
| 1968 | 83,591,694 | 16,941,293 |
| 1967 | 80,414,180 | 16,178,849 |
| 1966 | 78,122,965 | 15,516,895 |
| 1965 | 75,251,386 | 14,795,051 |

*Includes privately and publicly owned vehicles.

Source: Automotive Facts and Figures, MVMA, 1975

1) All classes of trucks included

Table IV-4

Nationwide
Fraction of Annual Travel by Model Year
for Light Duty Vehicles

| Age (years) | Fraction ot Total Vehicles in use Nationwide (a) | Average Annual miles driven (b) | a x b | Fraction of Annual Miles Traveled |
|---|---|---|---|---|
| 1 | 0.083 | 15,900 | 1,320 | 0.116 |
| 2 | 0.103 | 15,000 | 1,545 | 0.135 |
| 3 | 0.102 | 14,000 | 1,428 | 0.125 |
| 4 | 0.106 | 13,100 | 1,389 | 0.122 |
| 5 | 0.099 | 12,200 | 1,208 | 0.106 |
| 6 | 0.087 | 11,300 | 983 | 0.086 |
| 7 | 0.092 | 10,300 | 948 | 0.083 |
| 8 | 0.088 | 9,400 | 827 | 0.072 |
| 9 | 0.068 | 8,500 | 578 | 0.051 |
| 10 | 0.055 | 7,600 | 418 | 0.037 |
| 11 | 0.039 | 6,700 | 261 | 0.023 |
| 12 | 0.021 | 6,700 | 141 | 0.012 |
| ≥13 | 0.057 | 6,700 | 382 | 0.033 |

Source: Supplement No. 5 for compilation of Air Pollutant Emission Factors, AP42.

Table IV-5

**Nationwide**
**Fraction of Light Duty Truck Annual Travel by Model Year**

| Age, Years | Fraction of Total vehicles in use Nationwide (a) | Average Annual Miles Driven (b) | a x b | Fraction of Annual Travel |
|---|---|---|---|---|
| 1 | 0.061 | 15,900 | 970 | 0.094 |
| 2 | 0.095 | 15,000 | 1,425 | 0.138 |
| 3 | 0.094 | 14,000 | 1,316 | 0.127 |
| 4 | 0.103 | 13,100 | 1,349 | 0.131 |
| 5 | 0.083 | 12,200 | 1,013 | 0.098 |
| 6 | 0.076 | 11,300 | 859 | 0.083 |
| 7 | 0.076 | 10,300 | 783 | 0.076 |
| 8 | 0.063 | 9,400 | 592 | 0.057 |
| 9 | 0.054 | 8,500 | 459 | 0.044 |
| 10 | 0.043 | 7,600 | 327 | 0.032 |
| 11 | 0.036 | 6,700 | 241 | 0.023 |
| 12 | 0.024 | 6,700 | 161 | 0.016 |
| ≥13 | 0.185 | 4,500 | 832 | 0.081 |

Source: Supplement No. 5 for Compilation of Air Pollutant Emission Factors, AP42.

Table IV-6

Total Vehicle Miles Travelled
by Light Duty Vehicles

| Year | Nationwide[a] (billions of miles) | Los Angeles AQCR[b] (billions of miles) | New Jersey part of New York AQCR[c] (billions of miles) | Houston-Galveston AQCR[d] (billions of miles) | Phoenix-Tuscon AQCR[e] (billions of miles) | Denver AQCR (billions of miles) |
|---|---|---|---|---|---|---|
| 71 | | 44.6 | 27.0 | 11.3 | 8.22 | 5.60 |
| 72 | 986 | 45.9 | 27.6 | 11.9 | 8.63 | 6.09 |
| 73 | 1016 | 47.2 | 28.1 | 12.5 | 9.06 | 6.62 |
| 74 | 1046 | 48.6 | 28.7 | 13.2 | 9.51 | 6.82 |
| 75 | 1077 | 50.0 | 29.3 | 13.8 | 9.98 | 7.01 |
| 76 | 1100 | 51.5 | 29.9 | 14.5 | 10.5 | 7.23 |
| 77 | 1144 | 52.9 | 30.5 | 15.2 | 11.0 | 7.44 |
| 78 | 1177 | 54.4 | 31.1 | 16.0 | 11.6 | 7.67 |
| 79 | 1213 | 56.0 | 31.7 | 16.8 | 12.1 | 7.90 |
| 80 | 1249 | 57.6 | 32.3 | 17.6 | 12.7 | 8.14 |
| 85 | 1449 | 65.1 | 35.7 | 19.5 | 14.8 | 8.99 |
| 90 | 1679 | 73.8 | 39.4 | 21.5 | 17.1 | 9.91 |

a. Based on FHWA Highway Statistics and an assumption of a 3% growth rate after 1974.

b. Based on data from "Transportation Control Strategy Development for the Metropolitan L.A. Region", APTD-1372, Dec. 1972.

c. Based on vehicle registration data from New Jersey, census data relating the fraction of the population in AQCR, and on nationwide vehicle miles travelled average from AP42 Compilation of Air Pollution Emission Factors. Assumed 2% per year growth rate.

d. Based on Texas Highway Department Data. Growth rate assumed to be 5% until 1980 and 2% thereafter.

e. Based on Arizona Highway Department Data and growth rates of 5% until 1980 and 3% thereafter.

f. Based on Colorado Div. of Highways Data and assumed growth rates of 3% until 1980, 2% thereafter.

Table IV-7

Total Vehicle Miles Travelled
by Light Duty Trucks

| Year | Nationwide[a] (billions of miles) | Los Angeles AQCR[b] (billions of miles) | New Jersey part of New York AQCR[c] (billions of miles) | Houston-Galveston AQCR[d] (billions of miles) | Phoenix-Tuscon AQCR[d] (billions of miles) | Denver AQCR [f] (billions of miles) |
|---|---|---|---|---|---|---|
| 71 | | 4.39 | 3.22 | 1.35 | 1.19 | .667 |
| 72 | 156 | 4.51 | 3.28 | 1.42 | 1.25 | .725 |
| 73 | 160 | 4.64 | 3.35 | 1.49 | 1.31 | .788 |
| 74 | 165 | 4.78 | 3.42 | 1.57 | 1.38 | .812 |
| 75 | 170 | 4.91 | 3.49 | 1.64 | 1,45 | .835 |
| 76 | 175 | 5.06 | 3.56 | 1.73 | 1.52 | .861 |
| 77 | 180 | 5.20 | 3.63 | 1.81 | 1.60 | .886 |
| 78 | 186 | 5.35 | 3.70 | 1.90 | 1.68 | .913 |
| 79 | 192 | 5.50 | 3.77 | 2.00 | 1.76 | .941 |
| 80 | 197 | 5.66 | 3.85 | 2.10 | 1.85 | .969 |
| 85 | 229 | 6.40 | 4.25 | 2.32 | 2.14 | 1.07 |
| 90 | 266 | 7.25 | 4.69 | 2.56 | 2.49 | 1.18 |

a. Based on FHWA Highway Statistics and an assumption of a 3% growth rate after 1974.

b. Based on data from "Transportation Control Strategy Development for the Metropolitan L.A. Region", APTD-1372, Dec. 1972.

c. Based on vehicle registration data from New Jersey, census data relating the fraction of the population in the AQCR, and on nationwide vehicle miles travelled average from AP42 Compilation of Air Pollution Emission Factors. Assumed 2% per year growth rate.

d. Based on Texas Highway Department Data. Growth rate assumed to be 5% until 1980 and 2% thereafter.

e. Based on Arizona Highway Department Data and growth rates of 5% until 1980, 3% thereafter.

f. Based on Colorado Div. of Highways data and assumed growtb rates of 3% until 1980, 2% thereafter.

3. Nationwide Emissions

Table IV-8 and figure IV-1 show the results of an analysis such as is described in the preceding section. The figure shows that exhaust hydrocarbons will be reduced by 1990, but will have leveled off. Evaporative hydrocarbon emissions, if left uncontrolled, will contribute a much larger percentage of hydrocarbons than any other single mobile source by 1990. This fact is further illustrated in Figure IV-2 in which evaporative hydrocarbons will contribute roughly 66% of all hydrocarbons from mobile sources if no action is taken. Figure IV-2 also shows that a 6 g/test standard will significantly lower the percent contribution of evaporative emissions to total mobile source hydrocarbon emissions.

Figure IV-3 contrasts the effect of the alternative actions on nationwide hydrocarbon emissions from mobile sources from 1972 to 1990. It shows that, while emissions are expected to decrease significantly, much larger reductions will be realized if evaporative emissions are controlled by implementation of a 6 g/test standard in 1978.

Table IV-9 shows what reductions in hydrocarbons are expected by the year 1990. The 6 g/test standard implemented for 1978 and subsequent model years would lead to the reduction shown by

Table IV-8

Hydrocarbon Emissions from Mobile Sources ($10^6$ ton/year)

| | Exhaust Emissions[1] | | Crankcase Emissions[1] | | Exhaust & Crank-case and EVAP Emissions[2] | | EVAP Emissions (No Action)[3] | | EVAP Emissions (6 g/test standard)[3] | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | LDV | LDT | LDV | LDT | HDG | HDD | LDV | LDT | LDV | LDT |
| 1972 | 5.3 | 1.25 | .59 | .22 | 1.64 | .15 | 2.54 | .59 | 2.54 | .59 |
| 1975 | 4.7 | 1.04 | .15 | .08 | 1.53 | .16 | 2.45 | .61 | 2.45 | .61 |
| 1978 | 3.6 | .80 | .05 | .05 | 1.31 | .17 | 2.44 | .65 | 2.27 | .60 |
| 1980 | 2.7 | .69 | 0 | 0 | 1.19 | .18 | 2.50 | .68 | 1.89 | .49 |
| 1985 | 1.2 | .48 | 0 | 0 | .92 | .20 | 2.81 | .78 | 1.24 | .27 |
| 1990 | .71 | .41 | 0 | 0 | .83 | .23 | 3.26 | .91 | 1.10 | .17 |

1) Based on emission factors found in "Supplement No. 5 for Compilation of Air Pollutant Emissions Factors", AP-42

2) Based on emission factors found in "Second Addendum to Memorandum Entitled 'Revised Estimates of Total Nationwide Emissions for Various Regulatory Alternatives'." memo from S. Guy Forbes, EPA to Ernest S. Rosenberg, EPA, March 30, 1976. (Available in EPA public docket.)

3) Based on emission factors found in Tables IV-1 and IV-2.

Figure IV-1

Projected Nationwide Vehicle HC Emissions

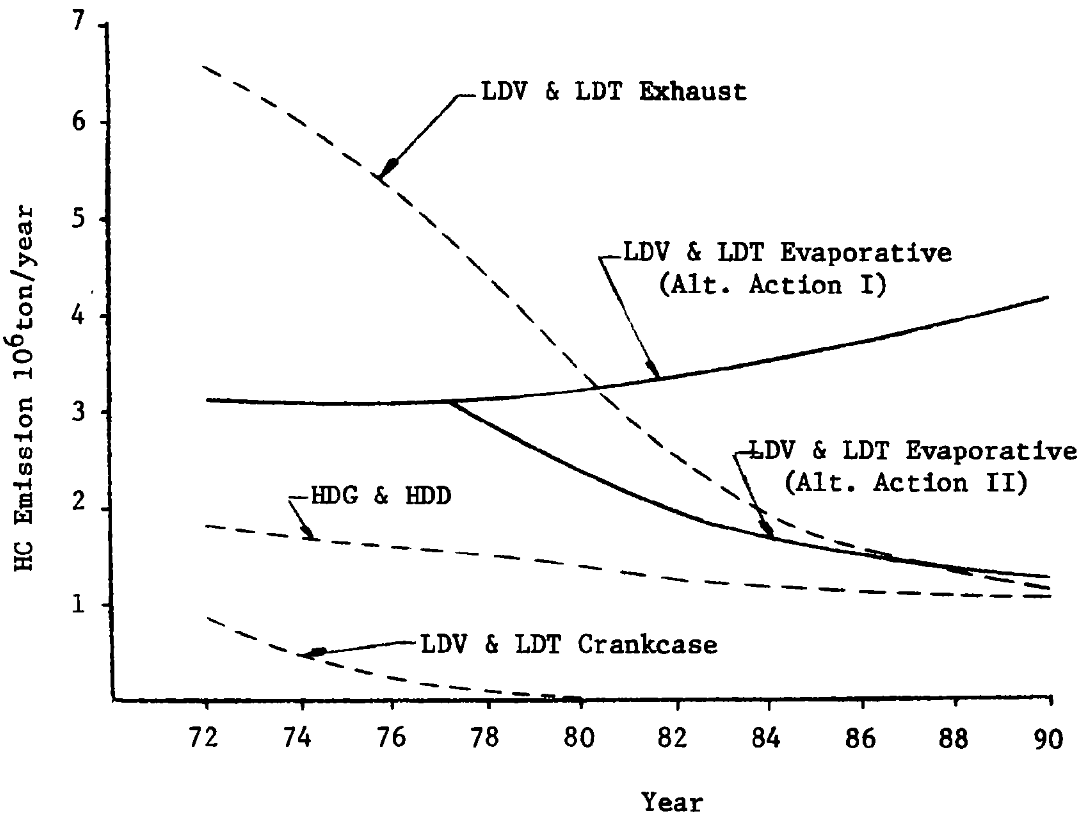

**Figure IV-2**

**Projected Percentage of Total HC Emissions from Mobile Sources Attributable to Evaporative Emissions from Light Duty Vehicles and Trucks**

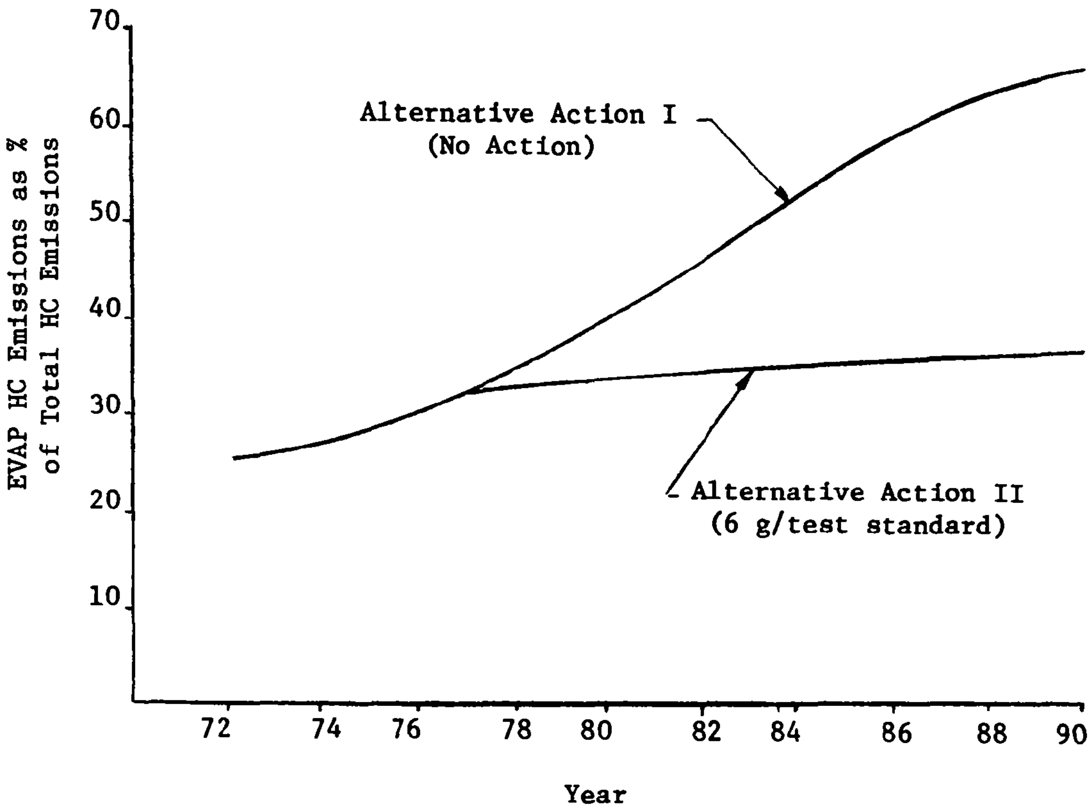

Figure IV-3

Projected Nationwide Hydrocarbon Emissions from Light Duty Vehicles and Light Duty Trucks

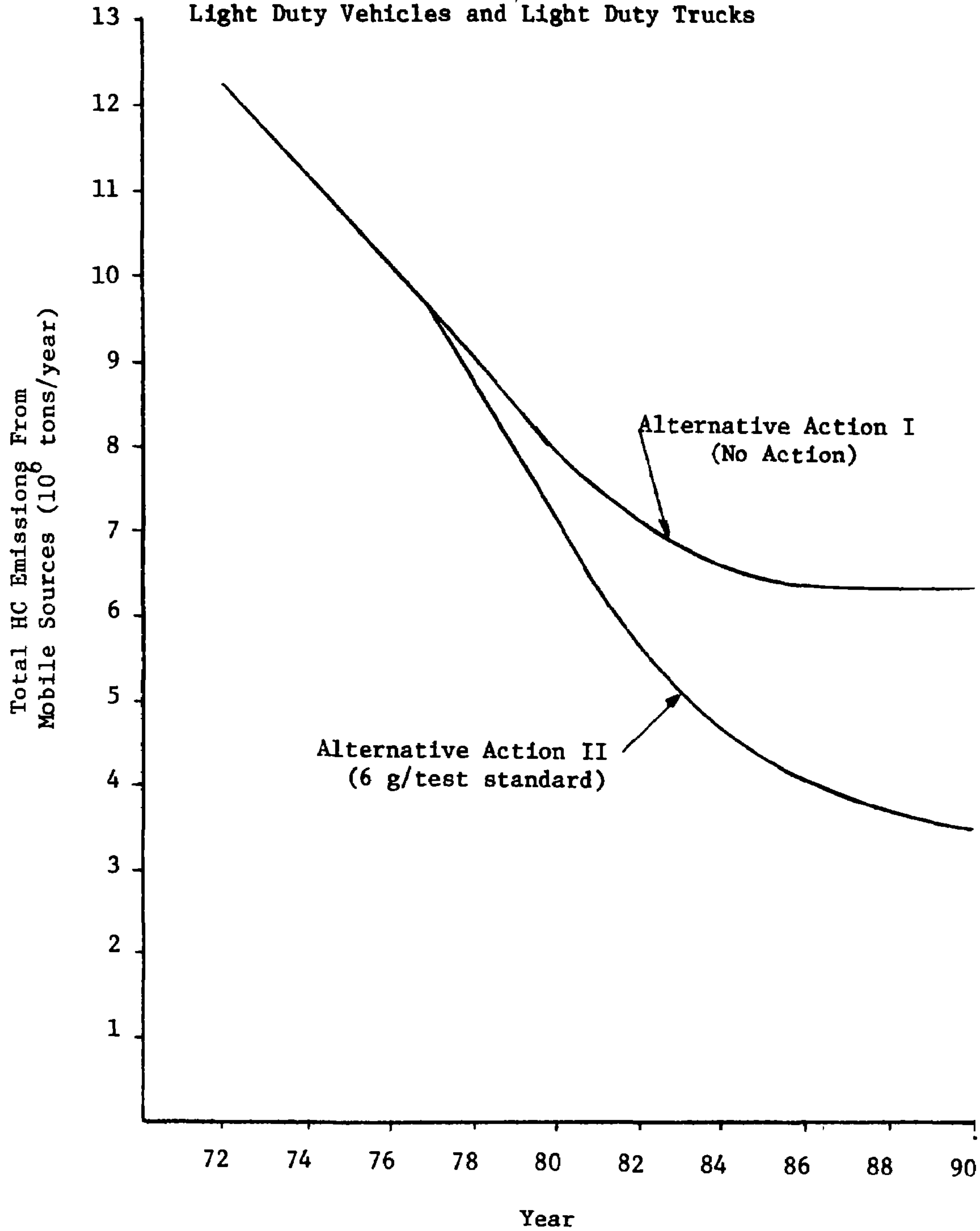

Table IV-9

Projected Nationwide HC reductions by 1990

| Action | Nationwide HC reduction in 1990 in $10^6$ ton/year |
|---|---|
| Alternative Action I | - |
| Alternative Action II | 2.9 |
| Reduce Exhaust Stds. to Statutory for LDV's | 2.0 |
| Inspection Maintenance[1] | .88-3.1 |

1) Source: Internal EPA memo from M. Williams to J. Lane, Aug. 18, 1975, assuming a 20% failure rate.

the year 1990. The table also shows the reductions that would be realized by the implementation of exhaust hydrocarbon emission standard in 1978 and the implementation of an inspection maintenance program.

4. Impact on Some Regions

Analyses have been performed which indicate that many Air Quality Control Regions may still be unable to meet established National Ambient Air Quality Standards for oxidants in 1985. These are listed in Table IV-10. Five of these regions have been analyzed to show what the effect would be of establishing a 6 g/test evaporative emission standard for 1978 and subsequent model years, as measured by the proposed Federal enclosure test procedure (alternative action II). Similar results would be expected from other regions listed in Table IV-10, but these regions have not been analyzed in detail.

The five Air Quality Control regions are Phoenix-Tuscon, Los Angeles, Denver, Houston-Galveston, and the New Jersey part of the New York Air Quality Control Region. Similar trends as the ones shown in Figures IV-1, 2 and 3 for national emissions existed for these AQCR's. More importantly, however, is what percent reductions in overall hydrocarbons will be achieved in these

Table IV-10

Regions of the U.S. Predicted
to Have Air Quality Problems in 1985
due to Photochemical Oxidants

Los Angeles
S. E. Desert
Houston-Galveston
National Capitol
San Francisco
San Joaquin
Sacramento Valley
San Diego
S. E. Texas
Phoenix-Tuscon
Denver
Corpus-Christi
NY-NJ-Conn.
Clark-Mohave
Dayton
S. W. Pennsylvania
Birmingham
Philadelphia
Boston
Cincinnati
Indianapolis
Genesse Finger Lakes
San Antonio

Source: "Air Quality Impact of Alternative Emission Standards for Light Duty Vehicles," OAWM, EPA, March 12, 1975 revision.

various regions due to this rulemaking action, and whether or not this will allow these regions to meet the oxidant ambient air quality standard. The percent reductions by 1980 and 1985 in total hydrocarbons by the implementation of a 6 g/test standard in 1978 are shown in Tables IV-11 and IV-12. It can be seen from Table IV-12 that, by 1985, Alternative Action II will reduce total hydrocarbon emissions from all sources by an average of 7.8%. A similar prediction for 1990 was not possible at the time this report was prepared, but the trend indicates that the percent reduction in hydrocarbons in 1990 would be somewhat larger than 7.8%.

The second important consideration is, whether or not the air quality control regions will be significantly closer to meeting the national ambient air quality standard for oxidants by 1990 with the implementation of this rulemaking. Table IV-13 shows the projected reductions in hydrocarbon emissions for implementation of a 6 g/test standard, and the maximum emission levels allowable for those regions to meet the standard. The amount of the reduction in hydrocarbon emissions by this rulemaking is equal to an average of about 50% of the level of hydrocarbon emissions which would allow those regions to just meet the ambient standard. The question of precisely how close this will bring these regions to their needed ambient levels in 1990 cannot be answered at this time, due to lack of projections of total hydrocarbon emissions to the year 1990, but it does appear that this action will take a major step in lowering hydrocarbon levels

Table IV-11

Effect of Alternative Action II in Reducing HC Emission Levels for Five Air Quality Control Regions by 1980

| AQCR | Predicted LDV emissions ($10^4$ ton/year) Alt. Action I (No Action) | Alt. Action II (6 g/test standard) | % Reduction in LDV emissions | % of Total[1] Hydrocarbons from LDV's | % Reduction of Total Hydrocarbons |
|---|---|---|---|---|---|
| New Jersey Part of New York AQCR | 15.8 | 14.3 | 9.8 | 38 | 3.7 |
| Phoenix-Tuscon AQCR | 6.64 | 6.06 | 8.7 | 27 | 2.3 |
| Los Angeles AQCR | 26.9 | 24.2 | 9.9 | 31 | 3.1 |
| Denver AQCR | 5.26 | 4.72 | 10.2 | 44 | 4.5 |
| Houston-Galveston AQCR | 8.63 | 7.79 | 9.8 | 19 | 1.9 |

Average Reduction 3.1%

1) Assumes statutory exhaust hydrocarbon standards implemented in 1978 and a metropolitan growth rate. Total hydrocarbons includes those from stationary sources.

Table IV-12

Effect of Alternative Action II in Reducing HC Emission Levels for Five Air Quality Control Regions by 1985

| AQCR | Predicted LDV emissions ($10^4$ ton/year) | | % Reduction in LDV emissions | % of Total[1] Hydrocarbons from LDV's | % Reduction of Total Hydrocarbons |
|---|---|---|---|---|---|
| | Alt. Action I (No Action) | Alt. Action II (6 g/test standard) | | | |
| New Jersey Part of New York AQCR | 10.7 | 6.82 | 36 | 28 | 10.0 |
| Phoenix-Tuscon AQCR | 4.74 | 3.20 | 33 | 16 | 5.2 |
| Los Angeles AQCR | 18.6 | 11.6 | 38 | 18 | 6.8 |
| Denver AQCR | 3.30 | 1.97 | 40 | 31 | 12.0 |
| Houston-Galveston AQCR | 5.84 | 3.72 | 36 | 12 | 4.3 |

Average Reduction 7.8%

1) Assumes statutory exhaust hydrocarbon standards implemented in 1978 and a metropolitan growth rate. Total hydrocarbons includes those from stationary sources.

Table IV-13

Projected Reductions in 1990 for Five AQCR's as % of Ambient Oxidant Standard

| | 1990 Reduction in Emissions due to Alternative Action II ($10^4$ tons/year) | Emissions Levels Allowable to Meet Ambient Std. ($10^4$ tons/yr)[1] | 1990 Reduction in Emissions as % of Allowable Emissions to Meet Ambient Standard |
|---|---|---|---|
| New Jersey Part of New York AQCR | 6.36 | 16.2 | 39% |
| Phoenix-Tucson AQCR | 2.88 | 11.1 | 26% |
| Los Angeles AQCR | 11.48 | 10.7 | 107% |
| Denver AQCR | 2.17 | 3.92 | 55% |
| Houston-Galveston AQCR | 3.47 | 10.1 | 34% |
| | | Average | 52% |

1) Levels shown obtained by using a proportional model

in those regions. However, this table does illustrate that evaporative emissions alone in 1990 without this rulemaking would average roughly half of allowable emissions needed to reach the oxidant air quality standard.

## B. Secondary Environmental Impacts

This section deals with the secondary environmental impacts of the alternative actions and for contrast includes the secondary impacts of reducing LDV exhaust standards to statutory levels. The secondary impacts that are discussed are 1) the effect on energy consumption, 2) the effect on the percent of reactive hydrocarbons emitted, 3) the possible interaction effect of evaporative emissions and exhaust emissions, and 4) the potential impact on water and solid waste pollution.

### 1. Energy Consumption

No change in energy consumption is anticipated through the promulgation of these regulations. Specifically, no increase in fuel consumption is expected as this should be relatively independent of the manufacturer's choice of evaporative control technology. Considering the fuel which is now lost to the atmosphere by evaporation, but which could be burned in the engine with evaporative control, one can describe a possible potential for conserving fuel.

Most evaporative control systems currently use a canister filled with activated carbon. Fuel vapors from the fuel tank and possibly from the carburetor fuel bowl are vented to this canister during periods when the vehicle is not in use. These fuel vapors are purged out of the canister during vehicle operation and burned in the engine. The establishment of a 6 g/test standard will reduce the amount of vapors lost to the atmosphere by 1.33 g/mi on the average. If a vehicle lifetime is assumed to be 100,000 miles, then this reduction would, over the lifetime of the vehicle, amount to approximately 40 gallons of fuel not lost to the atmosphere. At current gasoline prices this would suggest a potential savings of approximately $24 over the lifetime of the vehicle. However, this estimate assumes that all of the fuel trapped would be used efficiently. The actual use of this trapped fuel would probably be somewhat inefficient depending on the evaporative control system used, and therefore, savings would in all likelihood be much less than $24. However, any savings here would help offset the consumer-borne cost of control system discussed in the next chapter.

2. Hydrocarbon Reactivity

There is presently no indication of any direct health effects of the gaseous hydrocarbons in ambient air, although as reactants in the photochemical processes, hydrocarbons are linked with the adverse health effects of photochemical oxidants. This link with oxidants is the basis of hydrocarbon emission regulation.

"Hydrocarbon Reactivity" is the term used to denote the relative ability of a specific hydrocarbon to participate in photochemical reaction processes. For instance, a specific hydrocarbon may be involved in several reactions in the photochemical process, depending on its concentration, structure and oxidation state. The end products of these reactions and the consequent intensity of symptoms generated, such as eye irritation or plant damage, are largely dependent on the nature of the hydrocarbon involved.

The hydrocarbon compounds that are found in evaporative emissions are reactive. During instances when evaporative hydrocarbons remain in the atmosphere for a day or more such that there is sufficient reaction time, they are more reactive than exhaust hydrocarbons. Thus, the impact of this regulatory action on ambient air quality may be even somewhat greater than the reduction in overall hydrocarbon emissions indicates.

3. Exhaust Hydrocarbon Emissions Interaction

Depending on the design of the evaporative control system used to meet a 6 g/test standard, an interaction causing additional exhaust hydrocarbons and carbon monoxide to be generated from the combustion process can occur due to the purging of evaporative emissions into the engine. Whether or not this occurs is dependent on the rate and the total amount of hydrocarbons purged into the engine and the operating condition of the vehicle when purging takes place. While the test procedure is designed to assess potential evaporative emission-exhaust emission interactions, these interactions need not occur with proper utilization of existing control technology. Therefore, this rulemaking is not expected to have any measurable effect upon exhaust emissions.

4. Water Pollution and Solid Wastes

The problem of evaporative emissions is one which affects the air quality, and it is not one which should have any significant effect on water quality. The reduction of evaporative emissions should have very little positive and no negative effects on water quality. Similarly, no effect on the quantity or quality of solid wastes is expected. This is equally true of the control of hydrocarbon emissions by the implementation of the alternatives discussed dealing with controlling exhaust hydrocarbons.

# Chapter V

## Costs of Control and Its Impact on Consumers, Industry, and Government

### A. Impact on Consumers

From the consumer's perspective the costs of controlling emissions consists of two elements. First, there is a charge levied on the consumer by the vehicle manufacturer to cover the costs of the emission control system. This is usually done by increasing the "sticker" price of the vehicle. Secondly, the consumer must pay for any additional cost to operate and/or maintain the vehicle due to any change made to the vehicle, aimed at reducing emissions.

#### 1. Initial Costs

The initial cost to the consumer which is reflected in a higher sticker price, is due to the cost of research and development, production, design, raw materials, manufacturing and markup (profit) of any required component change or addition to the vehicle. For Alternative Action II, this cost will depend on the control strategy adopted by a manufacturer to meet a 6 g/test standard in 1978.

Table V-1 shows estimated costs for four alternative systems aimed at reducing evaporative emissions. Because of the similarities between light duty vehicles and light duty trucks, it is assumed that similar systems for reducing evaporative emissions would be used by both light duty vehicle and light duty truck manufacturers. The costs shown are the costs to manufacture the components specified. Systems I and II are equally capable of meeting a standard below the 6 g/test level as measured by the Federal enclosure method. The two systems are different in that the conceptual approaches to the problem of reducing evaporative emissions are different. System III and IV are capable of meeting a 6 g/test standard, but for System IV this would require a modification to the fuel used. Changes in fuel volatility, aimed at reducing evaporative emissions, will probably not occur and therefore System IV is not considered further.

It will be assumed that for the average light duty vehicle or light duty truck, System III costing $4.80 would be required to meet a 6 g/test standard. This assumption is in close agreement with the auto manufacturers' own predictions (see Chapter VIII).

The prices for the various systems shown in Table V-1 are the cost at the assembly plant. In order to obtain the wholesale price increase these values have to be increased by 6% for corporate overhead and this value increased by 12% to reflect corporate profit. The wholesale price for System III which is capable of meeting the standard for Alternative Action II is,

Table V-1

Component Costs for Systems Designed
to Meet New Evaporative Emission Standards

| System I | Cost Differential | |
|---|---|---|
| •Screw on gas cap similar to ones used by General Motors | + | $ .25 |
| •Steel fuel tank with a bladder and pressure setting of 30 inches of water | + | $25.00 |
| •Heat shielding between the exhaust pipe and the fuel tank | + | $ 3.00 |
| •Standard vapor-liquid separator | | |
| •Air cleaner with baffles | + | $ .50 |
| •Carburetor with an external bowl vent and heat shielding | + | $ 1.00 |
| •Closed bottom storage canister containing 700 gm of activated carbon | + | $ .15 |
| •Manifold purge system for the storage canister | | |
| TOTAL incremental cost impact per vehicle | + | $ 29.90 |
| **System II** | | |
| •Screw on gas cap similar to one used by General Motors with a pressure setting of 18 inches of water | + | $ .25 |
| •Heat shielding between the exhaust pipe and fuel tank | + | $ 3.00 |
| •Vapor-liquid separator with a smaller orifice to increase tank pressure | | |
| •Carburetor with reduced bowl capacity and external vent attached to a storage canister | + | $ .50 |
| •Two closed bottom storage canisters containing 700 grams of activated carbon each | + | $ 3.00 |
| •Manifold purge for both canisters | + | $ .50 |
| TOTAL incremental cost impact per vehicle | + | $ 7.25 |
| **System III** | | |
| •Improved gas cap gasket | + | $ .05 |
| •Heat shielding between the exhaust pipe and fuel tank | + | $ 3.00 |
| •Carburetor with reduced bowl capacity, external bowl vent, and heat shielding | + | $ 1.00 |
| •One storage canister containing 1000 grams of activated carbon and integral purge value (similar to Vega) | + | $ .75 |
| •Manifold purge | | |
| TOTAL incremental cost impact per vehicle | + | $ 4.80 |
| **System IV** | | |
| •Improved gas cap gasket | + | $ .05 |
| •Heat shielding between the exhaust pipe and fuel tank | + | $ 3.00 |
| •Carburetor with reduced bowl capacity and external vent attached to a storage canister | + | $ .50 |
| •Closed bottom storage canister containing 700 grams of activated carbon | + | $ .15 |
| •Manifold purge system | | |
| TOTAL incremental cost impact per vehicle | + | $ 3.70 |

NOTE: System IV requires the use of a low volatility fuel, RVP no higher than 6.8 psi, in conjunction with the vehicle modifications to achieve a reduced emission level.

Source: Assessment of Light Duty Vehicle Evaporative Emission Control Technology, EPA report, July, 1975.

therefore, $5.70.

In order to determine the actual price the consumer would have to pay (i.e., the retail price) the wholesale price is increased by 28%. This value is based on the historical dealer discount structure for General Motors.* A 28% increase in wholesale price would mean the consumer would pay an average of $7.30 more to purchase a vehicle capable of meeting a 6 g/test standard.

Table V-2 shows the total cost to U.S. consumers between 1978 and 1983. Also included is the increased production cost that the industry will experience. This production cost ($4.80 per unit) is passed on in the retail cost ($7.30 per unit) to the consumer. These costs were multiplied times the projected sales figures for light duty vehicles and light duty trucks during those years. The projected sales of light duty vehicles were generated by an econometrics model. Since similar econometrics modeling of light duty trucks has not been made at this time, it was assumed that the light duty truck market would be 25% of the size of the light duty vehicle market, as it was in 1974. The trend in truck sales in the last few years shows an increasing percentage of light duty trucks being purchased.

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*Discount data presented in Automotive News, August 18, 1975.

Table V-2

Incremental Costs of Control

| Year | U.S. Sales (millions) LDV[1] | LDT[2] | LDV+LDT | Increment Production Costs ($million)[3] Alternative Action II | Incremental Cost to the Consumer ($million)[4] Alternative Action II |
|---|---|---|---|---|---|
| 1974 | 8.7 | 2.1 | 10.8 | -0- | -0- |
| 1975 | 8.6 | 2.1 | 10.7 | -0- | -0- |
| 1976 | 9.9 | 2.5 | 12.4 | -0- | -0- |
| 1977 | 10.8 | 2.7 | 13.5 | -0- | -0- |
| 1978 | 11.4 | 2.8 | 14.2 | 68 | 104 |
| 1979 | 11.6 | 2.9 | 14.5 | 70 | 106 |
| 1980 | 11.5 | 2.9 | 14.4 | 69 | 105 |
| 1981 | 12.0 | 3.0 | 15.0 | 72 | 110 |
| 1982 | 11.6 | 2.9 | 14.5 | 70 | 106 |
| 1983 | 11.4 | 2.8 | 14.2 | 68 | 104 |

1) "Data Resources - U.S. Long Term Bulletin - Winter 1976", p. 20.
2) 1974 data from "Automotive News Almanac," 1975
   Predicted values (1975-1983) based on assumption that LDT market will be 25% of size of LDV market
   Values based on redefined LDT class (0-8500 lb. GVW)
3) Based on production cost of $4.80 for Alternative Action II
4) Based on retail cost increase of $7.30 for Alternative Action II

Thus, the assumption that light duty trucks will continue to be 25% of the size of the light duty vehicle market is probably inaccurate, but it should not cause large errors in the estimates of overall LDV plus LDT sales.

One limitation of the analysis shown in Table V-2 is the assumption that the costs of the pollution control system will remain constant over time (constant dollar assumption). Tending to reduce consumer costs are the cost saving engineering developments which are likely to occur as manufacturers gain more experience in using the system. Tending to increase costs to the consumer are the persistent increases in material costs that are likely to occur in the future. Accurate estimates of how these factors will cause costs to change are virtually impossible to make and thus the constant dollar assumption is required.

Another factor which ought to be considered in estimating aggregate costs of pollution control is the assumption that essentially all light duty trucks and passenger cars will use gasoline engines. Currently such an assumption is valid as practically all light duty vehicles and light duty trucks do use gasoline engines. However, some manufacturers are studying the possibility of using Diesel engines in light duty vehicles and light duty trucks. The extent to which Diesel engines are used in the future could tend to reduce EPA estimates of the aggreate costs of control, as Diesel fuels have a very low volatility resulting in very low evaporative emissions. It should be noted at this point that this regulatory action does not include Diesel powered light duty trucks and light duty vehicles for this reason.

2. Fuel Consumption

The control devices used for the containment of evaporative hydrocarbon emissions present no degrading effect on fuel economy and depending on the control strategy used, a cost savings due to fuel saved could occur. As was discussed in Chapter IV, a potential savings of 40 gallons of fuel over the vehicle lifetime could occur due to the trapping and subsequent burning of fuel vapors in the engine. At current gas prices of around $.60 per gallon this represents a potential lifetime savings of $24. As was pointed out earlier, only a fraction of that amount could actually be expected, but any savings would help offset the initial cost to the consumer. Since it is unknown how much could actually be saved, it will be assumed that no savings will be realized.

3. Maintenance Costs

Current systems are designed to last the lifetime of the vehicle without replacement or major maintenance of system components. Thus, for systems expected to be used to meet a 6 g/test standard, no maintenance cost should be encountered. Therefore, the initial cost to the consumer is the only cost he should have to bear as a result of this rulemaking.

## B. Impact on Industry

Manufacturers are faced with two tasks as a result of this rulemaking. First, they must adapt existing technology into specific hardware to accommodate their various models of light duty vehicles and light duty trucks. Secondly, they must minimize the cost of additional control devices and/or modifications to existing devices in order to minimize the impact on sales.

### 1. Sales

The first task is the most critical. It is clear that present technology is available and there is sufficient lead time for manufacturers to meet a 6 g/test standard for all 1978 model year vehicles. This was confirmed in the public hearing regarding California's Application for "Waiver of Federal Pre-Emption for Evaporative Emission Standard and Test Procedure", and in the comments received as a result of the proposed regulations (see "Summary and Analysis of Comments on the Proposed Evaporative Emission Regulations").

Increased production costs to the manufacturer as shown in Table V-2 will be passed on to the consumer as stated earlier. Thus, the cost to the motor vehicle industry will not be due to the cost of controlling hydrocarbons*, but will instead be due to any decrease in sales due to adverse consumer reaction to increased sticker prices. Generally, it can be stated that sales are inversely proportional to price changes. The degree of sensitivity to price changes is indicated by the price elasticity index. A price elasticity, for example, of .3 would indicate that a 1% increase in price would result in a 0.3% decrease in sales. The price elasticity for motor vehicles is .88.*

In 1974, 9,486,838 factory sales of light duty vehicles and light duty trucks were made by U.S. manufacturers for a total wholesale value of $29.8 billion. Thus, the average wholesale price of a 1974 light duty vehicle or light duty truck was $3,140. Based on this unit price, the wholesale price increase due to evaporative controls, and a price elasticity index of 0.88, the % drop in sales can be predicted. Table V-3 summarizes such an evaluation. Table V-4 shows the drop in actual sales for 1978 through 1983 for an assumed price elasticity of 0.88. As can be seen from Tables V-3 and V-4 the expected drop in sales due to the implementation of a 6 g/test standard in 1978 is very small compared to overall sales.

2. Competitive Structure

The effects of these regulations on the competitive structure of the light duty vehicle or light duty truck industries are

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* "The Effect of Tax and Regulatory Alternatives on Car Sales and Gasoline Consumption," Prepared for CEQ by Chase Econometric Associates, May 1974, p. 4.

Table V-3

% Drop in Sales Due to Evaporative Controls

| Action Taken | Wholesale Price Increase ($)[1] | % increase in Wholesale Price | % Drop in Sales[2] |
|---|---|---|---|
| Alternative Action I (No Action) | -0- | -0- | -0- |
| Alternative Action II (6 g/test Std. in '78) | $5.70 | 0.18% | .16% |

1) 1974 dollars

2) Based on price elasticity of 0.88 from "The Effect of Tax and Regulatory Alternatives on Car Sales and Gasoline Consumption," Prepared for CEQ by Chase Econometric Associates, May 1974, p. 4.

Table V-4

Drop in Actual Sales of Light Duty Vehicles and Trucks Due to Evaporative Controls from 1978 to 1983[1]

| Action Taken | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 |
|---|---|---|---|---|---|---|
| Alternative Action I (No Action) | -0- | -0- | -0- | -0- | -0- | -0- |
| Alternative Action II (6 g/test Std. in '78) | 23,000 | 23,000 | 23,000 | 24,000 | 23,000 | 23,000 |

1) Based on sales projections presented in Table V-2 and a price elasticity of 0.88 from "The Effect of Tax and Regulatory Alternatives on Car Sales and Gasoline Consumption," Prepared for CEQ by Chase Econometric Associates, May 1974, p. 4.

likely on the whole to be minimal. Historically, the market shares shown in Tables III-3 and III-4 in Chapter III have been quite stable and a minor price increase of 0.18% would not be expected to have any effect.

3. Developmental and Certification Costs

The manufacturers's cost of developing and implementing specific control systems has not been determined. At the California waiver hearing the main concern expressed by the manufacturers was lead-time and not specific costs.

Total capital costs to the manufacturer for certification have been estimated. It was assumed that the use of evaporative-system-families will reduce the number of evaporative emission tests by 50%, and that no increase in manpower will be required to run evaporative emission tests. Table V-5 gives the expected evaporative test load the manufacturers must bear for 1978. Bracketed values indicate the number of tests required if no reduction in test numbers is realized. It is estimated that a single enclosure is capable of being used for 15 tests per week and that the cost for an enclosure will be $15,000. In addition, each enclosure must be equipped with the required hydrocarbon analyzer console, temperature controller, and output recording devices. The estimated cost of these items is $10,000 per enclosure. In addition, exhaust ducting is required and additional space requirements to house the enclosure(s) may be needed. For

Table V-5

Manufacturers Increased Cost of Certification[1]

| Manufacturer | No. of Evaporative Certification Tests Per Year | Increased Cost of Certification Over 5 Year Period ($ thousand) | Increased Cost of Certification per year ($ thousand) |
|---|---|---|---|
| General Motors | 375 (750) | 115 (570) | 23 (114) |
| Ford | 260 (520) | 90 (445) | 18 (89) |
| Chrysler | 195 (390) | 90 (445) | 18 (89) |
| AMC | 110 (220) | 32 (132) | 6.4 (26) |
| Nissan (Datsun) | 50 (100) | 32 (132) | 6.4 (26) |
| Toyota | 65 (130) | 32 (132) | 6.4 (26) |
| VW-Audi | 210 (420) | 32 (210) | 6.4 (42) |
| IHC | 55 (110) | 32 (132) | 6.4 (26) |
| Totals | 1320 (2640) | 455 (2198) | 91 (438) |

1) Bracketed values assume no reductions in test load.

this analysis, the cost of the exhaust ducting will be included, but the possible cost of the additional space required will not. The cost of the additional space could be substantial, especially if a new building is required, but due to the difficulty of estimating such costs to the individual manufacturers it is not included. The additional manpower cost for certification testing to the manufacturer is included in the estimated costs shown in brackets, as some increase is expected if the test load is not reduced. Using these estimates, the total and annualized cost of certification over five years for each manufacturer has been calculated and is included in Table V-5. Thus, the increased cost of certification due to this rulemaking is expected to be about 1¢ per vehicle sold between 1978 and 1982.

4. Potential Impact on Employment

No production plant closures by any manufacturer of light duty vehicles or light duty trucks is anticipated due to the implementation of these regulations. The decrease in sales discussed earlier is expected to be very small and therefore its impact on employment at worst is expected to also be very small.

It is likely that increased engineering and manufacturing effort will be required to provide the new control systems. However, it should have a marginal impact on the size of the overall work force. Generally, the control devices required will be modifications or redesigns of existing devices, and thus, the major work effort will be in the engineering and skilled trades labor force.

C. Government Costs

This rulemaking will also have an impact on the EPA Motor Vehicle Emissions Laboratory. This impact will occur regardless of the level of control required since the test methodology primarily dictates the needs. The anticipated need will be for capital equipment. Additional manpower will not likely be required if the expected 50% reduction in test load is realized.

A facility modification will also be required which will cost an estimated $275,000. The total cost of this action to the Government is therefore estimated to be $400,000.

If a decrease in test load is not realized, additional manpower would be required to perform the same number of certification tests as are currently being conducted (approximately 3100 per year). Although the time-in-test remains the same, data acquisition, vehicle flow and soak space requirements would increase thereby necessitating an extended work day or the introduction of a second shift of operations. It is estimated

Table V-6

Estimated Equipment Acquisition Cost to the Government[1]

| Equipment Description | No. Required | Equipment Costs ($thousands) Unit Cost | Total Cost |
|---|---|---|---|
| Evaporative Emission Enclosure (SHED)[2] | 4 (6) | 20 | 80 (120) |
| HC analyzer console with temperature controller and output recording device | 4 (6) | 12 | 48 (72) |
| | | Total | 128 (192) |

1) Numbers in brackets indicate values if a 50% reduction in testing is not realized by evaporative-system families.

2) Includes exhaust duct work.

that eight additional technicians/engineers would be needed to support a second shift of operations. This additional manpower would cost $80,000/year. It is believed that with six enclosures and a staggered or second shift, that the same number of tests could be handled per day as currently are needed during peak certification testing.

D. National Annualized Cost and Capital Investment over 5 Years

The national annualized cost of attaining a 6 g/test standard for 1978 and subsequent model year vehicles is estimated to be $82 million* by the fifth year of implementation, 1982. Since there is no change in operating or maintenance cost associated with this action, the annualized cost is based entirely upon the annualized cost of five model years of control systems for cars and light duty trucks assuming a 10 year useful life (i.e., the value of the vehicle at the end of 10 years is zero) and a 10% anrual interest rate.

The national capital investment over the first five years is estimated to total $530 million*. This compares to a projected $230 billion* in retail sales of new cars and light duty trucks during the same time period, i.e., 1978-1982.

* 1974 dollars.

# Chapter VI

## Cost Effectiveness

One of the goals of the Mobile Source Air Pollution Control activity is to obtain clean air at minimum cost to society. For effectiveness in implementing this goal, a mechanism is needed by which the relative cost and effectiveness of the various mobile source emission control strategies can be assessed. Cost effectiveness (CE) is such a mechanism which assesses the cost per unit of desired result. In this case, cost effectiveness is expressed in terms of dollars per ton of pollutant prevented from entering the atmosphere. Once cost effectiveness is calculated for a series of control strategies, the strategies can be compared. The most efficient strategy is the one with the lowest cost necessary to control a ton of pollutant. In addition to the cost effectiveness of control, the amount of control available by the proposed strategy and the amount of control required to meet the air quality goal must also be known. Any given strategy can be very cost effective but not provide much pollution control. Alternately, a strategy might provide a large amount of pollution control but not be cost effective. Of course, the strategies which are both cost effective and which control large amounts of pollutants are implemented first. Other strategies are implemented as needed to meet air quality goals.

The most appropriate measure of the societal cost of control is the cost that the consumer must bear. This cost consists of an initial cost caused by an increase in the manufacturer's suggested retail price and a continuing cost which consists of the support or maintenance cost per unit of operation (e.g., per mile) for the life of the vehicle. For this rulemaking, the incremental operating costs are expected to be zero. The initial cost will consist of the cost to the manufacturer to attain the required control plus a mark-up (profit) which is at the discretion of the manufacturer.

The measure of effectiveness of control can most appropriately be determined by comparing the emission per unit of operation (per mile) from controlled and uncontrolled vehicles. The difference between the two represents the effectiveness of the control strategy in terms of mass per unit of operation (g/mile). The cost effectiveness (CE), then, is the ratio of the total vehicle cost to the total pollution controlled:

$$\text{CE (\$/ton)} = \frac{\text{Initial Cost + (Operating Cost, \$/mile) x (Total lifetime distance, miles)}}{\text{(Reduction in emissions, tons/mile) x (Total lifetime distance, miles)}}$$

For this cost effectiveness analysis, the assumption was made that an average vehicle or truck will last 10 years and travel 100,000 miles during that time. The assumption used for other mobile source control strategies, that the deterioration factor will remain constant over the 100,000 mile life of the vehicle, will be used here. This means that, when the vehicle meets the certification requirements at 50,000 miles, the average emission rate for the entire 100,000 mile period will be at or below the standards.

The g/mi reduction in emissions for light duty vehicles and light duty trucks is shown in Table VI-1. For the cost effectiveness analysis it will be assumed that by 1990 all vehicles will be emitting at a 6 g/test level, if alternative action II is implemented, and at statutory exhaust hydrocarbon emission levels, if they are implemented in 1978 for light duty vehicles and in 1980-82 for light duty trucks. This assumption is based on the fact that almost all vehicles will have been certified at those levels by 1990 and the proportion of vehicles old enough to have been certified at higher levels will be small.

Table VI-2 gives the costs for controlling a light duty vehicle or truck to the various levels discussed and also gives the calculated cost effectiveness for the alternative actions. Also included is the cost effectiveness of going to the statutory exhaust HC level and the cost effectiveness of an Inspection-Maintenance program. These other control strategies are included for additional comparison with the alternative evaporative control actions to show their relative cost effectiveness. The cost effectiveness of alternative action II and achieving statutory exhaust HC levels is in each case based on the composite LDV, LDT reductions from Table VI-1 and the costs shown.

Table VI-1

Reductions in HC Emissions from Light Duty Vehicles and Light Duty Trucks

| | Light Duty Vehicles | | Light Duty Trucks | | Composite LDV + LDT[1] | |
|---|---|---|---|---|---|---|
| | g/mi | g/mi reduction | g/mi | g/mi reduction | g/mi | g/mi reduction |
| Current Evaporative Emission levels[2] | 1.76 | ---- | 3.10 | ---- | 1.93 | ---- |
| 6 g/test Evap. Standard | 0.60 | 1.16 | 0.60 | 2.50 | 0.60 | 1.33 |
| Current and Planned[3] Exhaust Emission Standards | 1.50 | ---- | 1.70 | ---- | 1.53 | ---- |
| Statutory Exhaust Emission Level | 0.41 | 1.09 | 0.46 | 1.24 | 0.42 | 1.11 |

[1] Based on vehicle miles travelled by light duty vehicles being 87.2% of total vehicle miles travelled by light duty vehicles and light duty trucks.

[2] Supplement No. 5 for compilation of Air Pollutant Emission Factors, AP-42.

[3] Revised Standards for light duty trucks are planned for 1978.

Table VI-2

Unit Price and Cost Effectiveness
of Alternative Actions

| | Unit Price of Control | Cost Effectiveness $/ton HC |
|---|---|---|
| Alternative Action I (No Action) | -- | -- |
| Alternative Action II (6 g/test Std. in 1978) | $ 7.30 | 50 |
| LDV Exhaust HC Emissions to Statutory Level[1] | $62 - $164 | 500-1400 |
| Inspection Maintenance[2] | -- | 58-408 |

1) Source: "Analysis of Some Effects of Several Specified Alternative Automobile Emission Control Schedules", prepared jointly by EPA, DOT and FEA, April 8, 1976, p. 15. Assumes cost to achieve statutory levels for CO and HC are equally split, (e.g., 50% for CO, 50% for HC). Large range due to the large range of expected lifetime costs (which includes initial cost, fuel costs, and maintenance costs).

2) Source: Internal EPA memo from M. Williams to J. Lane, Aug. 18, 1975, assuming a failure rate of 20%.

# Chapter VII

## Other General Considerations

### A. Irreversible and Irretrievable Commitment of Resources

No irreversible and irretrievable commitment of resources is caused by this rulemaking. This rulemaking action will not cause any fuel consumption penalty, and commitment of resources such as steel, aluminum, and carbon for the evaporative emission control systems is so small as to be completely over-shadowed by normal market fluctuations.

### B. Relationships of Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity

This rulemaking will result in immediate reduction of hydrocarbon emissions from new light duty vehicles and light duty trucks and, as older vehicles are replaced with newer vehicles meeting the revised evaporative emission standards, will result in significant reductions in levels of oxidants in the ambient air. This reduction will also be beneficial and aid in the long term maintenance of ambient air quality levels.

No short term or long term losses to the environment are associated with this rulemaking. The timing and stringency of the standards are aimed entirely at the maximum reduction in evaporative hydrocarbon emissions in the shortest time period that will not result in undue economic dislocation to the light duty vehicle and light duty truck industry.

# Chapter VIII

## Problems and Objections Raised by Federal, State, and Local Agencies, and Other Persons

### A. Issue - Evaporative Emissions from In-use Vehicles

A 1973 EPA surveillance test program conducted tests using the SAE recommended procedure for measuring evaporative emissions in a sealed enclosure. The reported results of those tests on in-use 1973 MY vehicles showed a 31 g/test (diurnal plus hot soak) emission level, which is about 15 times the current 2 g/test standard. Review of that analysis indicated a computational error and the reported value should have been 26.5 g/test (roughly 13 times the current 2 g/test standard). The Draft Environmental Impact Statement did not use the 1973 program results, but instead used results from the 1972 program.

The 1972 surveillance test program, which was similar to the 1973 program, showed evaporative emissions at a 24 g/test level. The urban gram per mile equivalent of 24 g/test level is 1.76 g/mile as compared to the current Federal exhaust emission standard of 1.5 g/mile and the statutory goal of 0.41 g/mile. Thus, the amount of control over evaporative emissions thought to exist does not, in fact, exist. A study of the cost effectiveness of reducing evaporative emissions to a 6 g/test level from the 24 g/test level indicated it would cost $50/ton of pollutant removed. The cost effectiveness of reducing exhaust hydrocarbon emissions from the current standard of 1.5 g/mile to the statutory 0.41 g/mile level is between $500 and $1400 per ton of hydrocarbon removed. The urgency of the proposed evaporative emission regulations is based on the fact that a sizable reduction (24 g/test to 6 g/test) can be made initially and the cost effectiveness is better than other control actions.

In a letter* from the Motor Vehicle Manufacturers' Association (MVMA) to the EPA, the validity of the 31 g/test level reported for the 1973 surveillance program results was questioned. The validity of the results has been questioned due to a study by the California Air Resources Board (CARB), which indicates that a leak in the fuel cap could have resulted during the tests due to the insertion of a thermocouple wire through a drilled hole in the cap. Also, the MVMA cites the results of testing done by the manufacturers which show emission levels on 1975 vehicles to be at a 9 g/test level instead of 31 g/test. It is, therefore, charged that the environmental impact and cost effectiveness of the proposed regulations is not as good as indicated in the environmental and inflationary impact study and, therefore, the urgency of the proposal has been over-emphasized.

1. Summary of Comments

Council on Wage and Price Stability - The Council notes that industry questions the validity of the 31 g/test level reported by the

*Letter from L. E. Duffing, MVMA to R. Kruse, EPA, January 15, 1976.

1973 surveillance study. If levels are actually 9 g/test instead of 31 g/test, the cost effectiveness of the 6 g/test standard will be substantially less.

2. Discussion

EPA has responded to the letter from MVMA*. The response from EPA indicates that the alleged leaking gas caps should not have been a problem because pressure checks were performed prior to each test with the test cap in place. Therefore, the 26.5 g/test value should be valid. There still exists a large discrepancy between the results of that test program and results of tests by the manufacturers and the reason for this discrepancy has not been determined, but it may be due to vehicle condition at the time of test.

It should be emphasized at this point that the cost effectiveness of the proposed action was not based on the data from the 1973 surveillance program (31 g/test). Instead it was based on the results of the 1972 surveillance study which showed emissions to be at a 24 g/test level (1.76 g/mi equivalent). The 24 g/test level has undergone the scrutiny required to be incorporated as a part of the Compilation of Air Pollutant Emission factors, AP-42 (Supplement No. 5). The 31 g/test value from the 1973 surveillance program has not yet undergone such scrutiny and therefore is not used. The revised 26.5 g/test may undergo additional scrutiny and therefore will not be used in the final impact statement. The baseline emission rate of 1.76 g/mi for 1972-77 vehicles

*Letter from Mr. Ron Kruse, EPA, to Mr. Lou Duffing, MVMA, March 4, 1976.

will be used in the final impact statement as it was in the draft impact statement.

B. Issue - Cost of a 6 g/test Standard

The draft environmental impact statement estimated the cost of a 6 g/test standard to be $7.30 per vehicle based on a "typical" control system.

1. Summary of Comments

Council on Wage and Price Stability - "Based on data presented to the Council, it is assumed that the $7.30 cost of the 6 g/test standard is reasonable."

U.S. Department of Commerce - "On page 61 of the draft environmental impact statement (Table V-1), four alternative vehicle modification systems are proposed, with associated costs. There is no indication that these systems have been tested; to conclude at this stage that such combinations will meet emission standards may be premature."

2. Discussion

The range in vehicle price increase estimates supplied by the manufacturers was greater than anticipated, especially among the three largest U.S. auto makers. GM estimated a cost of $1 to $4 and Ford estimated a cost of $15. Apparently the proposed control systems to be used by these manufacturers may be quite different although the range in the evaporative emission levels of the 1976 model vehicles from these two manufacturers is not substantially different. The reasons for the substantially higher Ford estimate could not be ascertained. However, this suggests either a low cost effectiveness for the Ford system or that the Ford system was targeted for lower emission standards.

Exxon Research and Engineering has recently conducted an EPA contract test program which investigated the cost of vehicle modifications to reduce evaporative emissions.[1] As part of this program, the evaporative control systems of six production passenger cars were modified using several different types of modifications in order to demonstrate lower emission levels. At some point in the modification program, all vehicles reached an evaporative emission level below 6 g test. A sales weighted average of the estimated increase in vehicle retail price for these modifications was about $2. Although this cost estimate is based on limited data, it is in agreement with the cost estimate of $1 to $4, which was supplied by GM. Thus, it would appear this estimate of a system for compliance with a 6 g/test standard seems reasonable.

Based on the cost estimates received from the manufacturers,

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1. Clarke, P.J., "Investigation and Assessment of Light Duty Vehicle Evaporative Emission Forces and Control," Exxon Research and Engineering, EPA Contract #68-03-2172, April 1976.

sales weighted vehicle retail price increase required to meet a 6 g/test standard (assuming $2.50 for GM vehicles) is $7.40. The sales data were obtained from "Automotive News" for the 1974 model vehicles as listed in Chapter III. This sales weighted price increase of $7.40 is in agreement with the price increase estimate of $7.30, which was contained in the "Draft Environmental and Economic Impact Statement." The $7.40 estimate is higher than the $2 estimate made by Exxon, primarily due to the high $15 cost estimate given by Ford.

For estimating the economic impact of a 6 g/test standard it would seem most appropriate and conservative to use the manufacturers' sales weighted value. However, it is concluded that compliance with a 6 g/test standard appears feasible with an optimized control system for an increase cost of only about $2/vehicle.

3. Recommendation

Some recent data indicate that the required increase in sales weighted vehicle retail price may as low as $2. However, it is recommended that the conservative cost increase of $7.30 be retained for cost-effective and economic impact considerations. This estimate is the same as used in the draft impact statement and it closely agrees with the sales weighted average cost of the manufacturers' estimates.

## C. Issue - Lead Time for the 6 g/test Standard

The proposed Evaporative Emission Regulations published January 13, 1976, proposed a 6 g/test standard for 1978 MY vehicles using the enclosure test method.

### 1. Summary of Comments

U.S. Department of Commerce - "It is not clear from the draft impact statement that enough lead time has been provided to meet the standard of 6 g/test for the 1978 model year. There are several reasons to believe that certification of 1978 model year vehicles cannot be met unless the proposed regulations are promulgated by March, 1976. Among these items which should be addressed in the draft environmental impact statement are:

a. Preparation and manufacturer of components (engine, carburetors, etc.) well before the actual assembly of automobiles.

b. Cut off date for reporting certification test results by September 15 of year of market introduction of vehicles.

c. Allowance for testing of new technologies and for malfunctions in the 50,000 mile tests.

d. Production of, for example, 1977 model year automobiles, beginning in June, 1976.

2. Discussion

Concern over lead-time has been discussed in detail in the "Summary and Analysis of Comments" document prepared in response to the Notice of Proposed Rulemaking. The conclusion reached based on the information supplied by the manufacturers was that the 6 g/test standard is technically feasible and there is sufficient lead time for implementation for the 1978 model year.

D. Issue - Secondary Impacts

1. Summary of Comments

U.S. Department of Commerce - "On page 2, it is stated that 'The proposed action is not expected to have any effect on vehicle fuel consumption.' A similar statement is made in paragraph 3 on page 55 of the draft environmental impact statement. However, it is possible that driveability, levels of pollutants in exhaust emissions, and fuel economy, can all be adversely affected by some of the control systems suggested in the revised proposal. This aspect of the problem must be studied much more thoroughly than it has been. For example, one suggestion (page 6 of the Assessment Document) was to use fuels with a lower Reid Vapor Pressure (RVP). This would undoubtedly lower rates of fuel evaporation and lead to easier achievement of the 2 g/test standard. There is no indication, however, of how a vehicle designed to use one mix of various hydrocarbons will react to a fuel change involving different amounts of aromatics, paraffins and olefins. Nothing is now known about how it would start in cold weather, how it would drive under various conditions of weather and traffic, what the effect would be on fuel efficiency, and what would happen to exhaust emissions."

2. Discussion

Whether or not a driveability or exhaust emission interaction will occur is dependent on the evaporative control system strategy used by the manufacturer. Proper utilization of existing control technology can prevent these problems. It should be emphasized that solving these problems is at the discretion of individual manufacturers.

In reference to the example dealing with lowering the Reid Vapor Pressure, a study of fuel volatility done by Ethyl Corporation* indicates that "There were no starting problems with any fuel at any temperature, except for one 1968 car which had slow starts on all fuels at 20°F ambient." Also, "surge and rough idle were encountered under this procedure but were not affected by fuel volatility." Thus, lowering the Reid Vapor Pressure would not be expected to have a significant effect on starting or driveability.

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*"Study of the Interaction of Fuel Volatility and Automotive Design as They Relate to Driveability." CPA 22-68-66, CRC-APRAE CAPE 4-68 (2-68), Ethyl Corporation Research Laboratories.