cc: Mr. J. C. Frey
Mr. H. J. Gibson
Dr. R. A. Kehoe

August 9, 1948

Subject: Gibson's Report on "Vitol" Project

TO REGIONAL MANAGERS

COPY FOR ________________ REGION

Gentlemen:

We are sending under separate cover copies of a discussion of Van Hartesveldt and Holaday papers prepared by Harold J. Gibson of the Ethyl Corporation. This discusses the pros and cons of the "Vitol" project and the Thompson "Vitometer" equipment, as analyzed by our Research Department.

From our standpoint, we have not changed from the position outlined by Mr. Frey at the Regional Managers meeting on June 26. Ethyl is interested in the possibilities of this project and is studying and considering all aspects. Meanwhile, the company does not wish to appear against the program in any way, but at the same time is not a participant.

The health aspects are being studied by Dr. Kehoe. We understand that anyone who wishes to participate should let Dr. Kehoe know the circumstances, and he will arrange proper medical checks. Checks are now being made at the blending plants where "Vitol" is mixed, and we understand will also be provided at service stations or for fleets. The present schedule calls for a test sales campaign by Standard Oil Company of Ohio, Pure Oil Company, and Shell Oil Company at Columbus, Ohio, in September.

In answer to some questions you have raised on the health aspects, we have not been informed that this project has a clean bill of health nor have we any reports from Dr. Kehoe that he has run into hazards which would seriously handicap the program.

For convenience in having a full set of information in one place, it would be appreciated if you would write me direct, or send me a copy of pertinent letters or reports on this subject. We in turn will keep the field informed of progress.

Very truly yours,

O. B. Lewis

O. B. Lewis

OBL:IF
Att.

KE 0020738

N22008

DISCUSSION OF VAN HARTESVELDT AND HOLADAY PAPERS AT FRENCH LICK, JUNE 11, 1948

Prepared by Harold J. Gibson, Ethyl Corporation

Several of the preceding gentlemen have mentioned the probable need for stretching future petroleum supplies in order to allow for a greatly increased vehicle population in the future, and I will not dwell on that subject except to say that the possibilities in this situation are of great concern to all who are interested in the welfare of the oil and automotive industries. Any method or device which can contribute constructively to the solution of this problem deserves the best opportunity for commercial success which can be provided by the cooperation of all segments of the two industries.

There is no reason to believe that the mechanical problems associated with the Thompson Vita-Meter or the dual-fuel carburetor are insurmountable. Mr. Van Hartesveldt's paper indicates that his organization has recognized the problems involved in insuring that the antidetonant liquid reaches the right place at the right time, and is taking steps to correct the serious deficiencies which are evident in some applications of the early models of the injector. While experience with dual-fuel carburetors is very limited, it would seem that smooth and reproducible changeover would be the most difficult item to handle, and our experience has indicated that it can be solved satisfactorily.

Future use of injected liquids in passenger cars is predicated on the use of regular or premium grade gasolines as the base stocks, which makes the problem more complicated than when straight run stocks are used. Tests conducted in a car having a compression ratio of 10 to 1 and a requirement of 97 indicate a wide variation in the effectiveness of injected liquids when representative commercial gasolines are used instead of unleaded straight run materials. Injection of a mixture of 85% methanol, 15% water, and 3 ml TEL, at a rate equivalent to 17% of the gasoline flow rate, with straight run reference fuels resulted in a gain of 16 octane units, i.e., a change in requirement from 97 to 81. In this same car, two regular grade fuels rating 84 on the road were up-graded to 97, but two premium grade fuels were raised only from 92 to 97 at the same liquid flow rate. This difference in response represents a variation of roughly 2 to 1 in performance ability and might well be intolerable at this requirement level. Tests in other cars of a large number of representative premium and regular grade commercial fuels indicate that in the range of road ratings of 75-95, 20% injection of the above mixture will result in gains of 6 to 18 octane units in cars in which the liquid shows gains of 16 to 20 units with reference fuels. The differences in performance are undoubtedly due to distribution of the liquid, variations in the blending value of the alcohol in the different base stocks, the presence of varying quantities of TEL in the gasoline, the lead response of the base gasoline-alcohol mixture, and variation in the speed of maximum knock. These factors would need serious consideration in the application of the Vita-Meter principle to high compression ratio cars.

Any development of this type must eventually prove that it can pay its way by one means or another. If it offers convenience, additional freedom from user attention, or driving ease, its dollar-and-cents value in passenger car service need not be too carefully scrutinized. It is true, however, that commercial vehicle operators will look at it entirely from the standpoint of effect on costs. It is desirable, therefore, to examine the economics of the dual-fuel systems to see if they are likely to be sufficiently attractive to the user to outweigh their inherent disadvantages.

The first question to be answered is: How much antidetonant or high octane fuel will be used if these systems are applied? As a partial answer to this question we have studied the fuel consumption characteristics of a number of passenger cars and trucks under a wide variety of operating conditions. The data are summarized in Figure 1 which shows percentage of total fuel consumed at manifold vacua of approximately 6 in. Hg or less. This changeover point was chosen because test work indicated it to be about optimum when part and full throttle octane number requirements and overall consumption of high octane material are balanced against each other. Going to higher vacua results in excessively high consumption while lower values may result in excessive part throttle octane requirement. The bars at the top of the chart show maximum and minimum consumption in 1½ - 2 ton tractor-trailer units in eleven different inter-city operations in the mid and far-west. Gross loads varied from 13,000 to 37,000 pounds. The highest consumption shown is 93%. This occurred in a tractor hauling a trailer which had sufficient frontal area to limit the top speed to 43-45 miles per hour. In this type of service, wind loading is likely to govern top speed on substantially level roads, while gross load will control it on the steeper grades. The lowest consumption in the 11 different operations, part of which used stake-body trailers, was 60%.

The data for the 1½ ton stake truck, with a 10,000 pound gross load, indicate that city and inter-city service result in about equal ratios of consumption of high and low octane fuels in this type of truck. The passenger car data show an extremely wide range in relative consumption at full and part throttle. In mountainous terrain Car A used as much as 70% of the fuel at 6 in. Hg vacuum or less, while the same car used as little as 15% under other conditions. Car C in city-country driving with a 50 mph top speed used only 5%.

The data on Car B are also of interest. This car, of the same year and model as Car A, was driven over a 27-mile closed course in Detroit. Variation in consumption among the five drivers, who drove in their normal fashion, was from 15 to 40%. Two other drivers used this same vehicle in daily commutation service between Ferndale and Birmingham, Michigan with the results shown. It is a little difficult to decide what the relative consumption of high and low octane materials would be in this make and model of car. Data for Cars D and E were obtained with a maximum speed of 50 miles per hour.

With these figures in mind, it is desirable to consider the two types of dual-fuel systems individually. The foregoing gasoline consumption figures can be converted to injected liquid consumption by assuming an overall consumption of injected liquid equal to 20% of the full throttle gasoline consumption. (sufficient data are available to indicate that this gives a reliable estimate.) Figure 2 shows the economics of use of injected liquids as antidetonants only. It makes no attempt to evaluate savings in operating costs due to savings in maintenance since, so far as we know, there are no documented studies on this subject.

This figure shows the increased cost of fuel to the user as a function of cost of the liquid and rate of use. Two areas of cost are shown, one applying to commercial vehicles, and the other to passenger cars. We have arbitrarily set upper limits of 60 cents and one dollar per gallon for the cost of injected liquid for trucks and cars respectively, and lower limits of 18 and 25 cents which represent the approximate cost of gasoline to the two users. Injected liquids in truck service can cost as much as 10.8 cents per gallon of gasoline consumed, depending on rate of use and cost per gallon. Similarly in passenger cars the range is up to 14 cents. It is questionable whether the possible advantages of the system can compensate for the added cost of operation in many of these applications.

It is well to consider the possibilities of injected liquids in a system which will use them as high octane fuel blending agents, i.e. as both fuel and antidetonant. This system approaches that suggested by Mr. Holaday in that both are true dual-fuel systems. In one, a blending agent of high octane number would be added to the charge by the equivalent of the present power jet, while in the other a complete changeover takes place. Figure 3 shows increased cost of the total fuel used as a function of the differential in cost of the high octane material over that of the lower grade fuel, and the rate of use.

Comparison with Figure 2 indicates that there is a considerable advantage to be gained by giving the motorist something in addition to detonation control in return for his money. For passenger car use 14% consumption of injected liquid as an antidetonant at $1.00 per gallon would cost 14 cents extra per gallon of gasoline consumed, whereas the same consumption as fuel and antidetonant would cost 11 cents extra per gallon.

This same figure shows the savings to be made with a dual-fuel system of the type incorporating complete changeover. The average user drives 10,000 miles per year and buys about 700 gallons of gasoline for which, at 25 cents per gallon, he will spend $175.00. If he buys premium gasoline he must presently add $14.00 or about 8 per cent. If he uses the dual-fuel system, and his average consumption of high octane fuel is 25%, premium performance costs 0.5 cent per gallon. Thus he can save 75% of $14.00 or $10.50 at the current price differential.

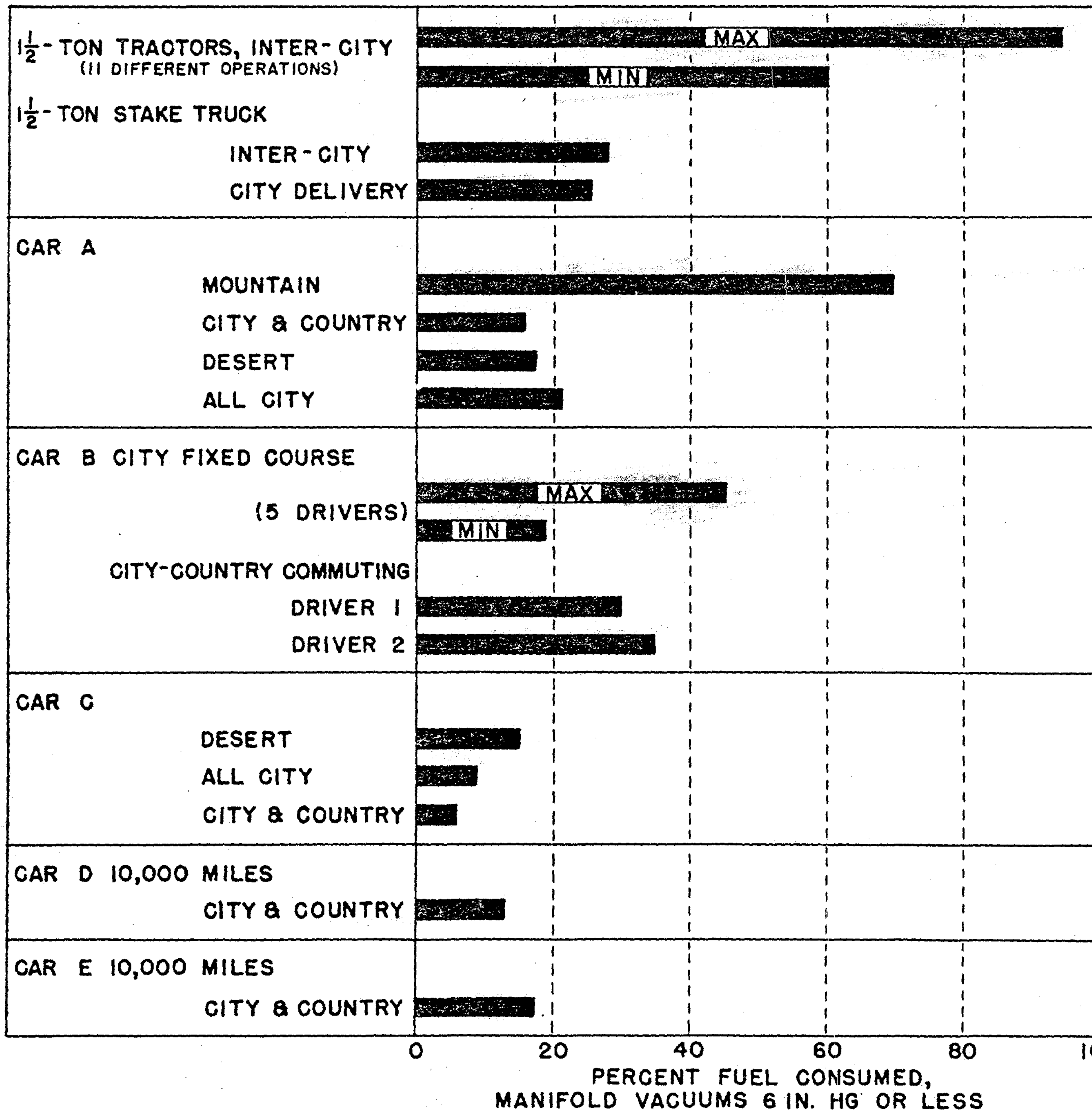
At this point one must consider the commercial as well as the engineering aspects; for to offer the oil and automotive industries any help in the solution of their supply problems, either method of detonation control must be purchased and used by millions of motorists or a substantial percentage of the truck and bus fleet operators. The psychology of a saving of even $10 a year can form the basis of a good sales argument but to offset that saving there is consumer inconvenience, which may even become a nuisance, of two fuel systems which must be maintained and furthermore must be kept in satisfactory balance so far as supply is concerned. As in all phases of automotive development, the extremes of users' acceptance are important. Consider a resident of Southern California who in his daily driving uses 15-25% of the high octane material and then goes to the mountains and uses 70%. How do you design for such variability? If tank sizes are proportioned on the basis of 25% consumption, say 15 gallons and 5 gallons, and consumption becomes 70%, then cruising range is that which can be obtained on the equivalent of about 7 gallons total.

This discussion is not meant to imply that these developments are not of significance. Rather, it is hoped that it will serve to emphasize the importance of considering all the factors involved in acceptance of any such system.

Harold J. Gibson

FIGURE I

RELATIVE FUEL CONSUMPTION FULL THROTTLE AND PART THROTTLE

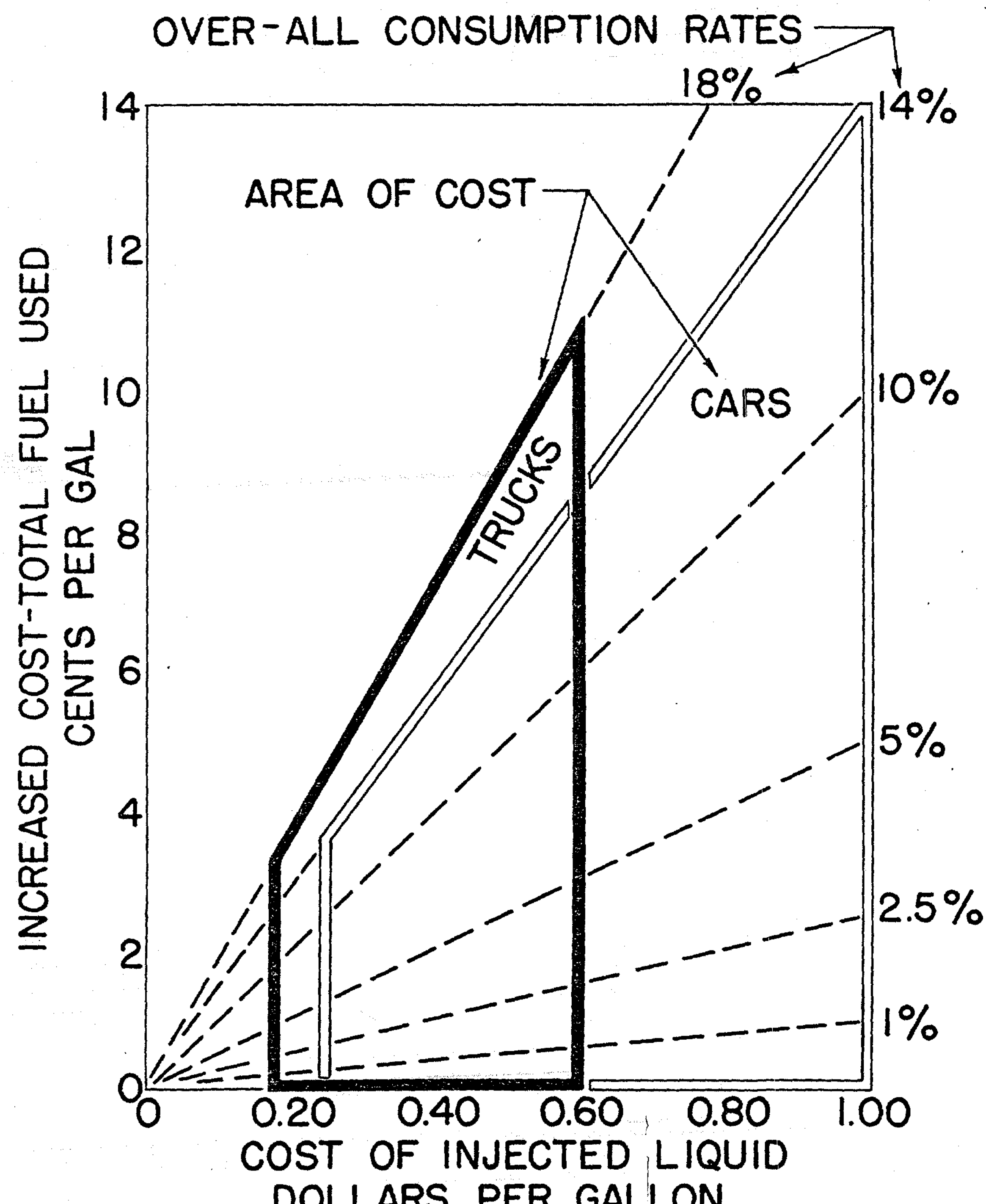


This figure shows the range in relative full and part throttle fuel consumption obtained in vehicles under a variety of operating conditions.

RE 0020742

FIGURE 2

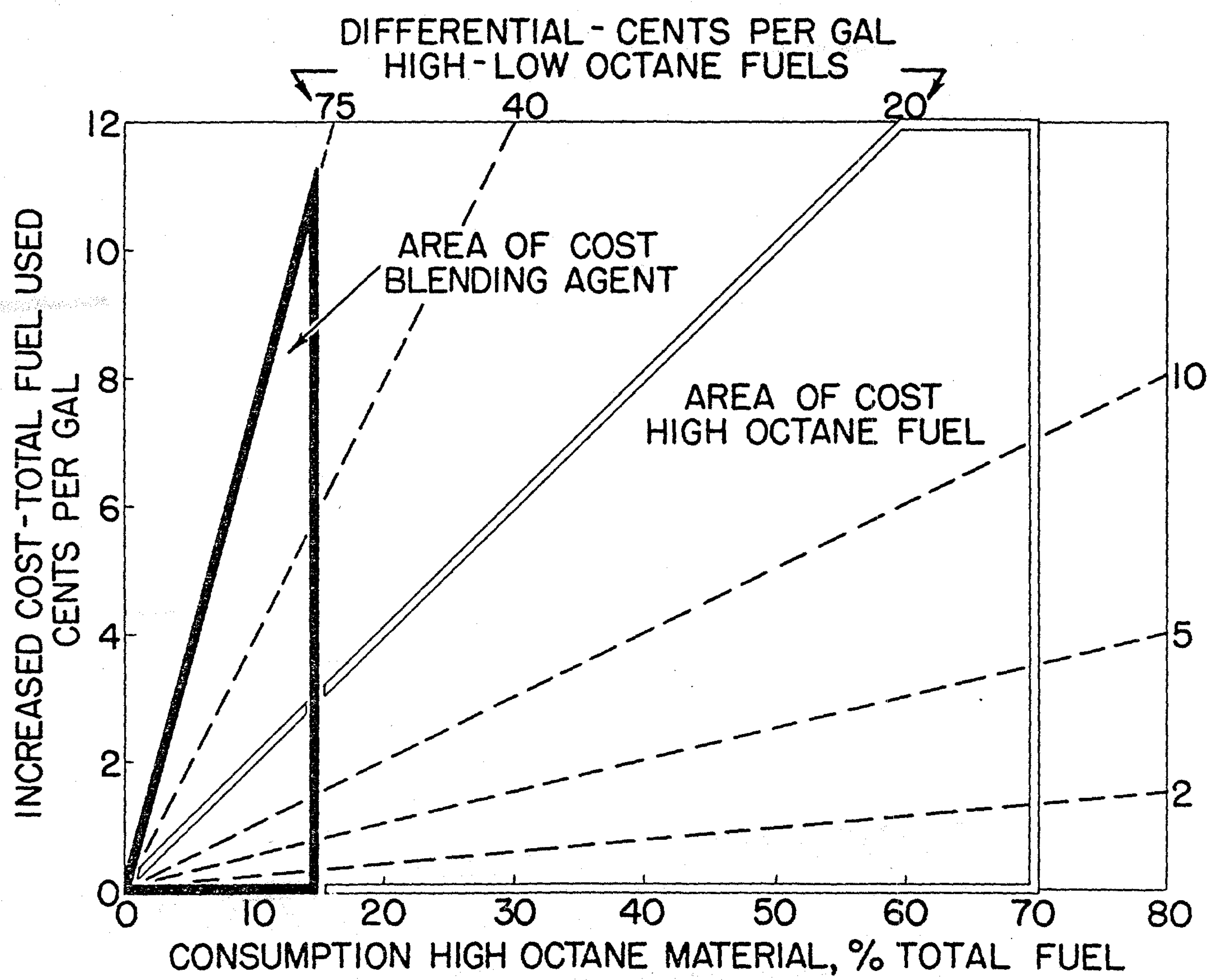
COST OF INJECTED LIQUID
AS ANTI-DETONANT ONLY



Boundaries of areas of cost are based on estimated cost of gasoline and an injected liquid to the two types of users, and the consumption rates shown in Figure 1. For example, maximum consumption for a passenger car is shown to be 70%. Applying the factor of 0.2 results in injected liquid consumption equal to 14% of total gasoline consumption. At $1.00 per gallon for injected liquid, this results in increased fuel cost of 14 cents per gallon.

FIGURE 3

COST OF HIGH OCTANE FUEL
DUAL FUEL SYSTEM CARS



Boundaries of areas are based on Figure 1 and differential in cost between high and low octane materials. For example, with low octane fuel at 25 cents a gallon a 75-cent differential is equivalent to a total cost of $1.00 per gallon for high octane blending agent. At 14% consumption, this increases total fuel cost by 11 cents per gallon.