CAN VEHICLE TRAVEL BE REDUCED 20 PERCENT IN THE SOUTH COAST AIR BASIN?

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This report covers a study to evaluate the possibility of reducing vehicle travel in California's South Coast Air Basin. Air pollution programs, analysis of travel, travel constraints, and reduction strategies are reviewed. The study concludes that a 20 percent reduction in VMT for the basin cannot be achieved in the short run because the automobile is more of a necessity here than in many other urban areas. This stems from the general form of the basin and its low population density. However, a 20 percent reduction is possible in the long run if area growth is controlled and land use is restricted.

•IN THE not too distant past, every city had a thriving public transportation system. But once Henry Ford had perfected his assembly line, it was only a matter of time until the automobile replaced the public conveyance in urban travel. The train, streetcar, and bus could not compete with the personal automobile. People bought cars and wanted roads. Public policy in this country was directed at providing highway facilities for the automobile.

Although these policies served the people well for over four decades, they are now being questioned. One of the public concerns is air quality, particularly in metropolitan areas.

The conflict between air quality and the automobile was first recognized in 1951 when Professor A. J. Haagen-Smit of the California Institute of Technology identified the photochemical process of smog formation. He deduced that automobile exhaust was the primary source of atmospheric pollutants in the Los Angeles area. The first efforts to reduce air pollution, taken by local government, were aimed at preserving both the right to breathe clean air and the privilege to drive. It is now recognized that travel must be curtailed to reduce air pollution.

CALIFORNIA'S AIR POLLUTION CONTROL PROGRAM

Los Angeles County formed an air pollution control district in 1947 that placed various controls on industry and later on individual households. Within the South Coast Air Basin, other control districts were formed and local regulations have become progressively more restrictive.

In 1962, the state formed the Motor Vehicle Emissions Control Board, which required various controls for new and used cars. The state broadened its control in 1967 by forming the State Air Resources Board (ARB).

ARB continued technical efforts to reduce emissions and in 1970 established ambient air quality standards for several pollutants.

One important point in the state's 1970 air quality standards (1) was the recognition that these standards could not be achieved by controlling exhaust pipes and smoke stacks alone. Restrictions in the use of the personal automobile would also be required.

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FEDERAL AIR POLLUTION PROGRAM

The 1970 California plan was to be carried out over a period of 15 to 20 years. Before the public had a chance to evaluate ARB's action, the federal government intervened with the Clean Air Amendments of 1970. As a result, the U.S. Environmental Protection Agency (EPA) established national ambient air quality standards that were more restrictive than those proposed by ARB. The major difference between the two plans was the time allowed for implementation. Instead of a transition period of 15 to 20 years, the federal program was to be implemented on what might be considered a crash basis—by 1975 or 1977 at the latest, as shown in Figure 1 (1). As required by the federal law, California developed an implementation plan for achieving the national ambient air quality standard for the state. It is in this plan that a 20 percent reduction in vehicle-miles of travel (VMT) in 1977 is proposed.

ANALYSIS OF TRAVEL IN THE BASIN

The number of registered motor vehicles in Los Angeles, Orange, Riverside, San Bernardino, and Ventura counties in 1972 was 6,182,482. Although the South Coast Air Basin does not include some of these counties in their entirety, the major portion of their population, vehicle registration, and travel is within its boundaries.

The Los Angeles Regional Transportation Study (LARTS) shows that 20,300,000 vehicle trips are made on an average weekday compiling 134,000,000 vehicle-miles (215 000 000 vehicle-kilometres) of travel. On the average Saturday or Sunday, 14,700,000 vehicle trips are made compiling 105,900,000 vehicle-miles (170 000 000 vehicle-kilometres) of travel.

Based on these figures, average Saturday or Sunday travel is 70 percent of average weekday travel and average Saturday or Sunday trip-making is 73 percent of average weekday trip-making. Other trip characteristics are given in Table 1.

LARTS data show that 628,400 trips are made daily to the central business district (CBD). This represents only 3.1 percent of the LARTS trips. Another survey was conducted on a significant length of a major freeway providing direct access to central Los Angeles. Approximately 6,260 postcards were handed out during this survey to drivers during the morning commuting period between 6:15 and 8:00 a.m. Nearly 2,560 of these were returned. Responses indicated that 300, or 12 percent, of the drivers were destined for the downtown area, 15 miles (24 km) away. This analysis shows that downtown commuting, even on freeways, is not the major reason for travel.

Transit service in the basin is provided by 13 public transit companies. In 1972 these companies operated 2,005 buses that traveled 78,700,000 miles (120 000 000 km) and carried 208,000,000 passengers. There is now no fixed-rail transit in the basin. The last fixed-rail transit facilities were abandoned in the early 1960s.

In 14.9 percent of the households in the LARTS area, no vehicle was available (1967 data). In 85.1 percent of the households, at least one vehicle was available; and in 44.1 percent, two or more vehicles were available.

Work-related trips had the lowest vehicle occupancy of all trip types. Average vehicle occupancy for each trip type is given in Table 2.

INCREASING THE USE OF OTHER TRAVEL MODES

An essential part of any program to reduce auto vehicle-miles traveled is the improvement of other travel modes. The following is an analysis of various proposals for improving these modes. (One suggestion for improving public transit, the development of rail rapid transit, has not been considered because it cannot be implemented by 1977.)

Improving Public Transit

Public transit currently accounts for slightly over 2 percent of the total person trips in the basin. It accounts for over 20 percent of all commuter trips to the Los Angeles CBD but only 5 percent of all commuter trips. In eastern cities the data indicate that 27 percent of all commuter trips are carried by public transit. Much of the reason for the small percentage in the Los Angeles area is the well-developed highway system.

There are, however, various steps that can be taken to make public transit more attractive and increase its use.

Preferential Treatment for Buses on Freeways—The time relationship between the highway system and the bus system, based on LARTS data, is shown in Figure 2. Plans are being made to provide preferential bus and car pool treatment, like the San Bernardino Busway, on other freeways to substantially change this time relationship.

The San Bernardino Busway runs parallel to the San Bernardino Freeway from El Monte to the east of downtown Los Angeles. The eastern seven miles is complete and ready for use. When the full 11 miles is in operation in 1974, the time savings for each passenger, compared to a bus trip without the exclusive lane, is expected to be 15 to 18 minutes. It is anticipated that when the lanes are open full length, bus volumes will reach 100 per hour.

The U.S. Department of Transportation also has a freeway operations improvement program in the Los Angeles area. One aspect of the program is to keep the freeways free-flowing by ramp metering. Traffic signals are placed at on-ramps to interrupt access to the freeway. In theory, the freeways remain uncongested and, once the motorist gets through the meter, he or she is compensated for the wait because the freeway is free-flowing. During the most congested period, delays due to traffic backup at the meter reach about 8 min. Buses are allowed to bypass the meter, thus saving passengers these 8 min.

Increased Public Transportation Service—Many people in the basin have no access to public transportation and are completely dependent on the auto. But even if it were possible to double the basin's transit fleet by 1977, only 4 percent of the total trips now being made could be handled. Table 3 (2, 3) gives a comparison of the availability of transit in the Los Angeles area to that of other large metropolitan areas in the east.

Encouraging Commuter Car Pooling

Based on the occupancy rate of 1.1 (Table 2) for private vehicle use for commuting in the basin, there are 11 people in each 10 cars driven to work. Obviously, if the vehicle occupancy were increased and the trip demand remained constant, there would be a decrease in total VMT.

During World War II when there was extreme rationing and a limited number of vehicles, the average occupancy during the peak period was 1.7 persons per vehicle. It is difficult to expect a higher vehicle occupancy now even with rationing. In California, a 1.7 vehicle occupancy during the peak period would result in a 30 percent reduction in home-work travel and a 7 percent reduction in overall travel. But a 7 percent reduction through voluntary measures is optimistic. A more reasonable figure might be 2 to 3 percent.

Improving Other Facilities

As restrictions are placed on the use of the automobile, both bicycle and pedestrian travel can be expected to increase and improvements in their facilities will be needed.

Bicycle Facilities—Most bicycle riding is for recreation, but bikes are a regular means of transportation for the young and some adults. Bicycle use in Europe (though decreasing at this time) indicates that this form of transportation could replace the automobile for some short trips. According to LARTS data shown in Figure 3, 10 percent of total VMT is for trips of less than 3 miles in length. Bicycling could become more popular in this range.

Bicycle sales are currently at an all-time high nationally, exceeding new car sales. One reason for this is the acceptance of the 10-speed bicycle, which makes it easier to pedal longer distances. Some small cities such as Davis, California, having experienced a marked increase in bicycle use, found it advantageous to build bike trails, designate special traffic lanes, and provide special bicycle parking facilities. More cities are following this example.

With increased bicycle use comes increased safety problems. In 1971 in California there were 8,573 bicycle injuries or deaths, an increase of 35 percent over the previous year. Better bicycle facilities could improve this safety record, but there is no ap-

Figure 1. Expected South Coast Air Basin oxidant levels.

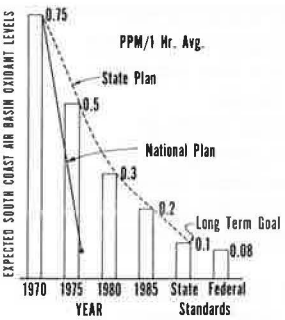

Table 1. Trip characteristics and relationships.

Trip Type	Average Length of Weekday Trips (miles)	Daily VMT (percent) Five Day	Seven Day
Home-work	9.0	32	25
Work-other	7.2	11	
Home-shop	3.0	7	75
Home-other	5.7	27	
Other-other	4.7	23	
All trips	5.9	100	100

Note: 1 mile = 1.6 km.

Table 2. Vehicle occupancy rates.

Trip Type	Average Weekday	Average Saturday Sunday
Home-other	1.7	2.0
Other-other	1.3	1.6
Work-other	1.1	1.1
Home-work	1.1	1.1
Home-shop	1.4	1.5
All trips	1.4	1.8

Figure 2. Automobile bus 30-minute isochrone from downtown Los Angeles.

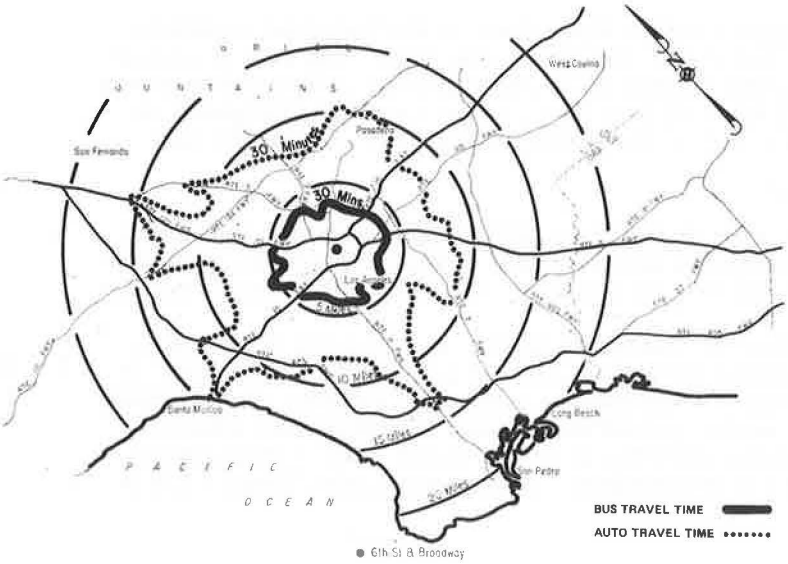

Figure 3. Distribution of miles driven by trip length for all trip types.

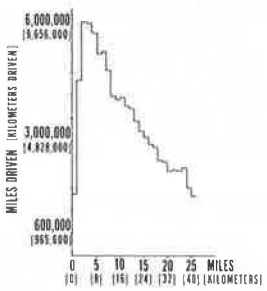

Table 3. Availability of transit.

Area	Commuter Trips by Transit (percent)	Available Daily Seat-Miles per Person
Los Angeles	4.8	1.00
New York	39.0	4.88
Boston	20.1	2.65
Chicago	24.4	2.89
Baltimore	16.9	1.94

Note: 1 mile = 1.6 km.

Table 4. Reduction strategies.

Strategy Description	VMT Reduction (approximate percent)
Improved public transit	3
Improved public transit and tax on auto use	4
Auto-free zones	0.6
Increased parking cost	Negligible
Four-day workweek	0.6
Exclusive bus and car pool lanes	2.5
Exclusive bus and car pool lanes[a]	3.2
Increased commuter car pools[b]	4.4

Note: The percentage figures cannot be totaled because some of the strategies are competitive.

[a]With 3 cents per mile tax.
[b]Average freeway automobile occupancy of 1.5.

Figure 4. World and U.S. vehicle registrati of cars, buses, and tru

parent economically satisfactory way to provide for the bicycle on crowded city streets or along many busy highways or freeways.

Pedestrian Facilities—The public does not generally view walking as a substitute for auto travel. Nationally, about 5 percent of the work force walks to work (4). This, of course, includes workers in all of the small communities. The percentage for the basin would be expected to be less.

There are currently many needs for improving pedestrian facilities and, no doubt, these improvements would attract additional walkers, but improved pedestrian facilities cannot be expected to result in any measurable reduction in total vehicle travel.

Reduction Strategies

Others have come to the conclusion that it is difficult to attract people into using other modes of travel. Preliminary analyses indicate that some reduction in VMT could be achieved by using various strategies (5). The strategies and the percentage of reduction estimated are given in Table 4.

Data given in Table 4 are based on the optimistic assumption that there will be no increase in travel demand. Considering the low demand for public transit as a substitute for the private car, it is most unlikely that any of the estimated reductions will be reached.

PROPOSALS FOR RESTRICTING THE USE OF THE AUTOMOBILE

The data presented in the preceding section lead one to conclude that the goal of reducing VMT by 20 percent cannot be achieved by merely improving other travel modes and relying on voluntary shift. The next step in planning to meet the goal is to analyze methods of restricting the use or reducing the utility of the private car.

Rationing

Rationing by one method or another is most often suggested for reducing travel. The arguments for rationing are (a) it has the potential of providing equally for all people, (b) it does not require large initial expenditures on the part of individual motorists, (c) we have prior experience with rationing, (d) results are immediate, and (e) the program can be terminated at any time. There are, of course, many administrative and enforcement problems.

Some proposals suggest that rationing be applied only during the smoggy season (summer and autumn). But, people must have an alternate mode to meet their travel needs. It is not economically practical to provide for this by having a large standby bus fleet for use only during this rationing period.

If the amount of fuel allowed each individual were based on individual needs, then gas rationing could provide some degree of equity for all people. People could compete equally for the limited supply of fuel. This is the ideal case. In reality, however, many individuals would find "special deals," and we could expect black-marketing problems similar to those which occurred during World War II. One suggestion for overcoming enforcement problems is to have an open market for ration stamps. This is the system currently being considered by the federal government. Regardless of the specific method used, the ration area would have to be extended beyond the basin limits by approximately 100 miles (160 km) to prevent frequent trips across the border to obtain unrationed fuel.

Reducing the supply of fuel to individuals by 20 percent would not result in an equal drop in vehicle travel. Rationing would accelerate the swing to small cars and motorcycles. The switch to smaller vehicles would offset actual emission reductions, since exhaust pollutants are a function of miles driven and are not directly related to the fuel consumed (6).

Mileage Quotas

Another way to reduce travel is to assign mileage quotas for each automobile. If the automobile is driven more than the quota allows or if inspections indicate that the odom-

eter seal has been broken, the owner could be fined or the vehicle impounded for a period of time. This procedure could have many variations. Individual cases could be examined in an attempt to provide greater fairness or the system could be used to place even more stringent restrictions on older high-emission vehicles than on newer low-emission vehicles.

Odometers would be checked at annual inspections, roadside checks, and at change of ownership. Border checks would have to be set up in order to adjust quotas for mileage driven outside the basin.

Taxation

Many proposals for restricting automobile use are directed at increasing the price of operating a vehicle to the point where people will reduce vehicle travel. This is an application of the traditional market mechanism for allocating goods.

There has been little effort to increase vehicle taxation to cover the cost of air pollution. For example, California's annual agricultural losses due to air pollution have been estimated at $44,000,000. If 80 percent of this loss is associated with vehicle emissions, it would cost about $5 per vehicle to compensate for these losses. The figure would be higher if all vehicle-related air pollution losses were incorporated in the cost of operating the automobile.

The perceived marginal cost for any given short automobile trip is near zero (7). In planning a program to reduce vehicle travel, it may be more important to increase the perceived cost than the actual cost. Unfortunately, most of the methods suggested for increasing the perceived cost include frequent but inefficient methods of collecting the tax. These "frequent reminder" taxing methods, such as toll collection, though they could be set high enough to discourage vehicle use, involve high collection cost and thus reduce available revenue that could be used to improve alternate modes of transportation.

There is little empirical data for using high taxes to limit fuel sales. All evidence indicates that the price-demand elasticity for gasoline is very small. In some European countries where fuel costs are the equivalent of $0.80 to $1.00 a gallon ($0.21 to $0.26 a litre), the use of the automobile is increasing at 10 to 20 percent per year (8). Figure 4 (10) shows the worldwide increase in vehicle ownership. Large increases in vehicle use are occurring in areas where income levels are much lower than in the basin and where effective public transit systems are available.

If the people of the basin should select a high gas tax as a method of reducing travel, additional research would be required to develop a recommended taxing level. Demand forecasts developed by others indicate an order of magnitude of the price elasticity of demand for motor fuel of 0.16 to 0.07. If 0.10 is used as an arc elasticity over the range in question, then the price of gasoline (including tax) would have to be increased by 200 percent to achieve a 20 percent reduction in the fuel sales. This means that fuel now costing $0.38 per gallon ($0.10 a litre) would have to be priced at $1.10 per gallon ($0.29 a litre) to reduce consumption by 20 percent.

Another approach to increasing the cost of motor fuel is to limit the total amount of gasoline sold in the basin by rationing fuel at the wholesale level and then letting the retail price respond to demand. The supply and demand would probably equalize when prices reach the range reported above.

REDUCING THE CONVENIENCE OF THE AUTOMOBILE

A major reason that the automobile enjoys overwhelming popularity is that it is the most effective system yet devised for fulfilling many personal desires. Flexibility and convenience are two of these desires but there are others. Henry Ford II was quoted as saying, "When you put a fellow behind the wheel, he gets a different feeling about himself. It is a feeling of independence that he is not likely to get on a bus or a train" (9).

One approach that could be used to reduce vehicle travel is to limit its flexibility and convenience and, therefore, its ability to satisfy the users' desires by restricting automobiles from certain areas, increasing trip time by lowering speed limits, and limiting the days that certain vehicles can be driven.

The following are some often-suggested methods for reducing travel and conclusions as to their usefulness.

Restricting Through Traffic

The traffic passing through the basin is less than 1 percent of the total travel. Because of the geographical size of the basin and the difficulties in bypassing it, there is no justification for restricting through traffic.

Changing the Workweek

There are several ways that a reduced workweek can be set up, but in this analysis we assume that a four-day plan is spread over six working days, Monday through Saturday, and that 80 percent of the labor force is on the four-day workweek. A 15 percent reduction in work travel could then be expected.

Because commuter driving represents about 31 percent of workday travel, we should expect 6 percent weekday travel reduction. However, many additional miles would be driven on the extra day off. As reported in the section on travel analyses, normal Saturday or Sunday travel in the basin is only about 20 percent below weekday travel. Personal travel on the extra day off might be somewhat less than on Saturday or Sunday because children would be in school and spouses would be working. At best, the four-day workweek might achieve a 4 percent reduction in VMT.

Limiting Growth and Development

Limitations on population growth and urban expansion in the basin have a great potential for limiting travel in the long run. But within a five-year period, reversing current population trends or modifying land-use patterns would be difficult. Even if all residential and commercial building were curtailed, greater use of existing facilities would allow continual population increase and dispersion in the basin in the short run.

SUMMARY AND CONCLUSIONS

A 20 percent reduction in vehicle travel cannot be achieved in the short term by attracting people to other travel modes. The reluctance to give up the personal automobile has been attributed to many factors, including its superiority in meeting personal requirements such as the desire for privacy, flexibility, and convenience.

There are other factors that make the automobile more of a necessity in the basin than in many of the other urban areas. This stems from the general urban form and the low population density. The population density for Los Angeles is about one-half that of San Francisco, Washington, D.C., and Chicago and one-fourth that of New York City. These high-density cities all have considerably more use of public transit than does the Los Angeles metropolitan area.

The suburban types of developments that are characteristic of this area are directly associated with the low population density and high vehicle use. To compound the problem, primary access to many employment opportunities and new shopping facilities is by private motor vehicle. If this characteristic life-style expands, the difficulty of providing adequate public transportation will increase.

A substantial reduction in VMT by 1977 cannot be achieved through voluntary measures. Neither can it be achieved by improving public transportation nor by incentives for using other travel modes. It will have to be accomplished by the use of constraints. If constraints are placed on the use of the automobile, it is clear that car pools will be formed, transit service expanded, walking and bicycle use increased, and many trips shelved. Some of the vehicle travel constraints that are discussed in this report could be combined into an acceptable package aimed at meeting the goal of reduced VMT. Some proposals such as increasing the availability of public transportation in the basin and providing preferential freeway access for buses and car pools to maintain free-flow conditions would appear to be valuable portions of any plan. However, the major effort to control VMT growth in the long term must be in land-use restrictions and areawide planning.

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