

america's highways: where are they taking the environment?

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The thesis of Alvin Toffler's thought-provoking book, *Future Shock*, is that man is careening into the future at so great a rate that he is undergoing a vast psychological and sociological upheaval. Toffler notes that, in 1914, the typical American traveled about 1,640 miles per year and about 88,560 miles during his lifetime. Today, by contrast, the average American automobile owner drives 10,000 miles a year, and it has been estimated several million human beings will have covered 3 million miles or more during their lifetimes.

Toffler goes on:

The aggregate figures are staggering. In 1967, for instance, 108,000,000 Americans took 360,000,000 trips involving an overnight stay more than 100 miles from home. These trips alone accounted for 312,000,000,000 passenger-miles.

Even if we ignore the introduction of fleets of jumbo jets, trucks, cars, trains, subways and the like, our social investment in mobility is astonishing. Paved roads and streets have been added to the American landscape at the incredible rate of more than 200 miles per day for at least the last twenty years. This adds up to 75,000 miles of new streets and roads every year, enough to girdle the globe three times. While United States population increased during this period by 38.5 percent, street and road mileage shot up 100 percent. Viewed another way, the figures are even more dramatic: passenger-miles traveled within the United States have been increasing at a rate six times faster than population for at least twenty-five years.

I am neither a social scientist nor a highway engineer. But I think that contemplation of figures such as these suggests, at least in part, an answer to the question posed in the title of this paper: *America's Highways: Where Are They Taking the Environment?* At the very least, it seems clear that they are taking environmental problems to the farthest reaches of our nation—and doing it mightily rapidly.

What, then, are some of these problems, and how should they concern us?

The impact of highways on water pollution is perhaps not so obvious, or so direct, as is the case with other environmental difficulties, but an example may serve to show the kinds of solutions we should be looking for.

The Environmental Protection Agency recently conducted a study of erosion and sediment deposition resulting from highway construction and land development activities. It concluded that the cost of correcting these problems often is unjustifiably transferred to the taxpayer rather than to those benefiting from the development; that the technical capability of controlling erosion and sediment deposition is available; that the cost of effective control probably is minimal; and that the principal problem lies in achieving effective administrative control and enforcement by concerned agencies.

A more obvious environmental insult related to highways—or, more properly speaking, to their use—is noise. An estimated 250 square miles adjacent to freeways or highways have a noise impact affecting about 2.5 million Americans. Of the 3 billion total highway vehicle-miles traveled in 1970, better than half were within town or city limits. In addition, traffic over the 96,000 miles of major arterial roads in suburban communities exposes 7 to 14 million persons to objectionable noise levels.

Tires are the dominant noise source when vehicle speeds are greater than 50 mph. The amount of tire noise is also a function of the road surface, axle loading, and tread design and wear condition. Truck tires are generally noisier than automobile tires. Engine-generated noise is normally dominant for trucks and automobiles at speeds below 35 and 45 mph respectively. This noise is radiated directly from the engine exhaust and intake openings and from the vibrating engine casing. The turbulent aerodynamic flow over the vehicle body and the rattling of loose mechanical parts are also sources of highway noise.

Improved engineering design may be expected to bring decreases in noise from all types of vehicles. Ultimately, however, we may have to look to changes in highway design features to provide shielding between the highway-generated noise and those who live and work near highways.

Finally, in the area of air pollution, we may have the most complex problem—both to define and to resolve. It is not my intent to go into detail on the subject. But a brief overview of some of the major factors is necessary to direct attention to the areas in which further study and planning are most vital.

In setting the national ambient air quality standards on April 30, 1971, for 6 major air pollutants, the EPA Administrator noted that Americans in several urban areas may have to change their commuting habits if the standards for the motor-vehicle-related pollutants are to be achieved. Much publicity has arisen in many of these communities about the need for one or more forms of transportation control—including, for example, vehicle inspection and maintenance, traffic flow improvements, increased transit usage, car-pooling, motor vehicle restraints, and work-schedule changes.

At the present time, our data base is too narrow to allow us to quantify the total potential environmental impact of each of these possible emission reduction approaches. Most are being studied intensively either by our staff or under contract. Although we can speak to probable qualitative results, we cannot yet clearly define how, and to what total degree, air quality in cities will be affected.

Basically, of course, the federal program to restore clean air—as it relates to motor vehicle emissions—depends on whether vehicles can retain their low emission characteristics under all conditions of operation, including those imposed by present road and highway strictures. Indeed, federal vehicle emission standards and testing procedures are based on driving patterns dictated by the way people drive their cars in cities. But those driving patterns are, in turn, dictated by present street and highway patterns.

However, those strictures pose some intriguing problems. In addition, several transportation control measures that have been contemplated are based on restricting emissions from the vehicles themselves and obtaining additional reductions in emissions, where needed, by restructuring the way in which the present street and highway system is used.

For example, studies are now being completed to show how much additional reduction in total emissions could be gained by installing retrofit control systems on uncon-

trolled or partially controlled vehicles. These, of course, assume that the vehicles will continue to be driven in the same way and over the same street systems as they now are.

The same is true of related ideas such as conversion of a portion of the vehicle population (fleets especially) to other fuels such as liquefied petroleum gas or liquefied natural gas. In the latter cases, of course, consideration must also be given to possible unfavorable trade-offs. Diverting natural gas to vehicle use in a given urban area, for instance, could mean that this fuel would be less available for use in heat or power generation. And this, in turn, might well result in increased consumption of fuels that would increase emissions of sulfur oxides.

Other methods considered for vehicle pollution reduction assume no further control of individual vehicle emissions but consider altering the way in which the vehicles use the existing street and highway systems.

In particular, thought has been given to methods for improving traffic flow. Typically, these methods are directed toward decreasing number and length of delays, idle times, and stops and starts on the vehicle-carrying system. The net effect of these changes would be to increase average vehicle speed. For a given traffic volume, carbon monoxide and hydrocarbon emissions decrease with increasing average speed. On the other hand, improving traffic flow is likely to result in increasing the total volume of flow. Thus, traffic flow improvements related to increased average speed might be counter-productive. Again, our present knowledge does not allow us to quantify the environmental impact.

Let me suggest, briefly, 2 other interesting concepts worthy of thought.

Absent any reduction in individual vehicle emissions, or gross alteration of traffic flow patterns, one should expect atmospheric pollutant levels in the central city portions of our major urban areas to approach, asymptotically, a relative maximum, as the street system becomes saturated. Thus, the additional development of street and highway systems in the total urban area would result in expanding the area of pollution impact outward from the central city. This effect, in fact, has been noted and measured. Increasingly, then, the expanding highway system has extended the area of impact into the suburbs. The development of the street and highway system has allowed people to escape the environmental insult of the city but has brought the environmental insult along with them.

The Interstate Highway System provides for travel around many major urban areas. Presumably, emissions from vehicles using these routes would not add to pollution levels in the central city area. But, clearly, they will add to levels in the suburban areas where these beltways are typically located. Although we cannot quantify the effect at this time, there may be a greater impact on the central city area than first considerations might indicate. Because of the highway configuration, vehicle emissions will ring the city; and, no matter what the wind direction, the air moving across the city will contain contaminants from the vehicles.

How do all of these many factors interrelate? What is the net impact when all of the trade-offs are considered? How can we optimize the combination of vehicle emission control, vehicle use, and highway design and location? Unfortunately, we are unable to say at this time. But, these questions must be asked, they are being asked, and we are developing the answers.

We started with the question, Where are highways taking the environment? The answer is, To where it now is—at least as far as motor-vehicle related pollution is concerned. However, the real question is, Where should the environment take highways? Quite likely, honest and objective answers to that question will result in sweeping changes in the future development of the total transportation system.