ENVIRONMENT

- **Will additional automobile emission controls be necessary?**
- **Which of the various emission= control measures offer the greatest potential?**
- **What environmental problems are involved in the evolution of new technologies?**

Environmental problems created by widespread and intensive automobile use include air pollution, noise, disposal of scrap vehicles, and water contamination. The Technical Report examines each, but we consider air pollution to be the most important, and consequently most of our attention has been devoted to this problem.

Until recently, the amount of atmospheric pollutants emitted bv automobiles had been growing each year. Emission controls required by the 1970 Clean Air Act and its amendments are helping to reverse this trend. Base Case projections for the year *2000,* assuming compliance with the 1977 Clean Air Act amendments and no other automobile controls, show that automobile emissions for the country as a whole will be reduced from their current levels, even though automobile travel is expected to grow by 75 percent. Carbon monoxide and hydrocarbon emissions from automobiles are projected to decrease by about **60** percent each. The reduction in nitrogen oxide emissions will be smaller—about *30* percent.

Why then is there still an automobile emission-control problem? Base Case projections show that despite the progress made in reducing auto emissions, air quality in a significant number of our urban areas 'will fall short of the standards established by the Clean Air Act. In part, this will be attributable to automobile emissions because:

- Air pollution in congested urban areas at peak traffic times is and will continue to be caused largely by automobiles.
- The emission-control devices now in use may lose much of their effectiveness if not properly maintained, resulting in higher levels of emissions from the average car on the road.

National aggregate air pollution figures do not fully reveal the effects on the population in areas of extensive and concentrated automobile use—chiefly the central parts of cities, but sometimes the surrounding suburbs as well. In urban areas, where population density and automobile use are the greatest and where air pollution from nonautomobile sources also tends to be high, it is estimated that between 125- and 150-million people are now exposed, at least once during the year, to concentrations of carbon monoxide or photochemical oxidants that exceed established Federal standards. The effects of this exposure on human health cannot be calculated with certainty. Estimates vary both as to the danger and its *importance* for the more vulnerable segments of the population — infants, the elderly, and those with respiratory or cardiac disorders. However, the evidence clearly indicates that atmospheric pollution (to which the automobile is a major contributor) is cause for serious concern.

Projections of regional air quality in 1985 and 2000 show that violations of the carbon monoxide and oxidant standards, though decreasing, will still be common occurrences. In 2000, about 10 percent of the 247 Air Quality Control Regions in the United States are expected to experience violations of the carbon monoxide standard. Violations of the standard for photochemical oxidants are expected in almost 25 percent of the regions. Because these violations will generally occur in the most populous areas, the number of persons exposed to hazardous con-

Supporting detail for this section of the Summary and Findings is contained in chapter 6 of the Technical Report.

	1975	1985	2000
Emissions (millicn tons per year):			
Carbon monoxide	69.3	32.6	27.3
Hydrocarbons	7.9	3.5	2.9
Nitrogen oxides	4.0	2.7	2.9
Particulate	0.38	0.08	0.25
Air quality:			
Carbon monoxide:			
Number of AQCRS exceeding standard	43	34	22
Number of AQCRs exceeding 2 x standard	25	3	2
Total violations	68	37	24
Photochemical oxidants:			
Number of AQCRs exceeding standard	49	46	41
Number of AQCRs exceeding 2 x standard	20	11	8
Number of AQCRs exceeding 3 x standard	8	2	3
Number of AQCRs exceeding 4 x standard	7	3	2
Total violations	84	62	54

NOTE: CURRENT AND PROJECTED AUTOMOBILE EMISSIONS AND AIR QUALITY DATA indicate improvements in auto emissions but also show that air quality in a significant number of the 247 Air Quality Control Regions (AQCRs) in the United States will fall short of national clean air goals. The CO standard is 10 mg/m³ in an 8-hour period. The oxidant standard is 160 μg/m³ in a 1-hour period.

centrations of air pollutants will remain very high—perhaps as many as 135 million persons, or about half the population, in 2000. Since automobiles are particular] y heavy contributors to peak concentrations of carbon monoxide and photochemical oxidants, additional measures to control exhaust emissions may be needed to improve air quality in urban areas.

Automobiles are not the only source of air pollution. Other transportation modes, industrial plants, power-generating facilities, commercial establishments, and home heating also contribute substantial amounts of pollutants to the atmosphere. It seems evident that, if the Nation is to attain the air quality goals established by the Clear Air Act, measures to reduce all sources of air pollution must be considered.

However, the focus here is on automobile air pollution and means to reduce emissions from this source. We considered the following measures:

- further tightening of new car emission standards (specifically for nitrogen oxides);
- mandatory inspection and maintenance of emission-control devices; and
- control of automobile use in specific locations.

In addition to these three alternatives, we also considered the possible environmental effects of the introduction of new automobile propulsion systems or fuels.

Further Tightening of New Car NO_x Emission Standards

The various oxides of nitrogen (collectively designated NO,) are singled out for two reasons. First, projections of atmospheric pollution under Base Case conditions show that NO_x emissions will be the major air quality problem in coming years, and unless more stringent measures are adopted to control NO_x emissions from all sources, air quality in many urban areas in 1985 and 2000 will be little better than today. Second, the most serious aspect of the NO_x problem is likely to be how to controI the magnitude and duration of peak concentrations, which often coincide with rush-hour automobile traffic. Thus, a more stringent NO, standard for automobiles may be an important strategy.

Lowering the new car emission standard for NO, to 0.4 gram per mile could reduce the national aggregate of NO_x emissions from 2.9 to 2.2 million tons per year by 2000, However, compared with the potential improvement af-

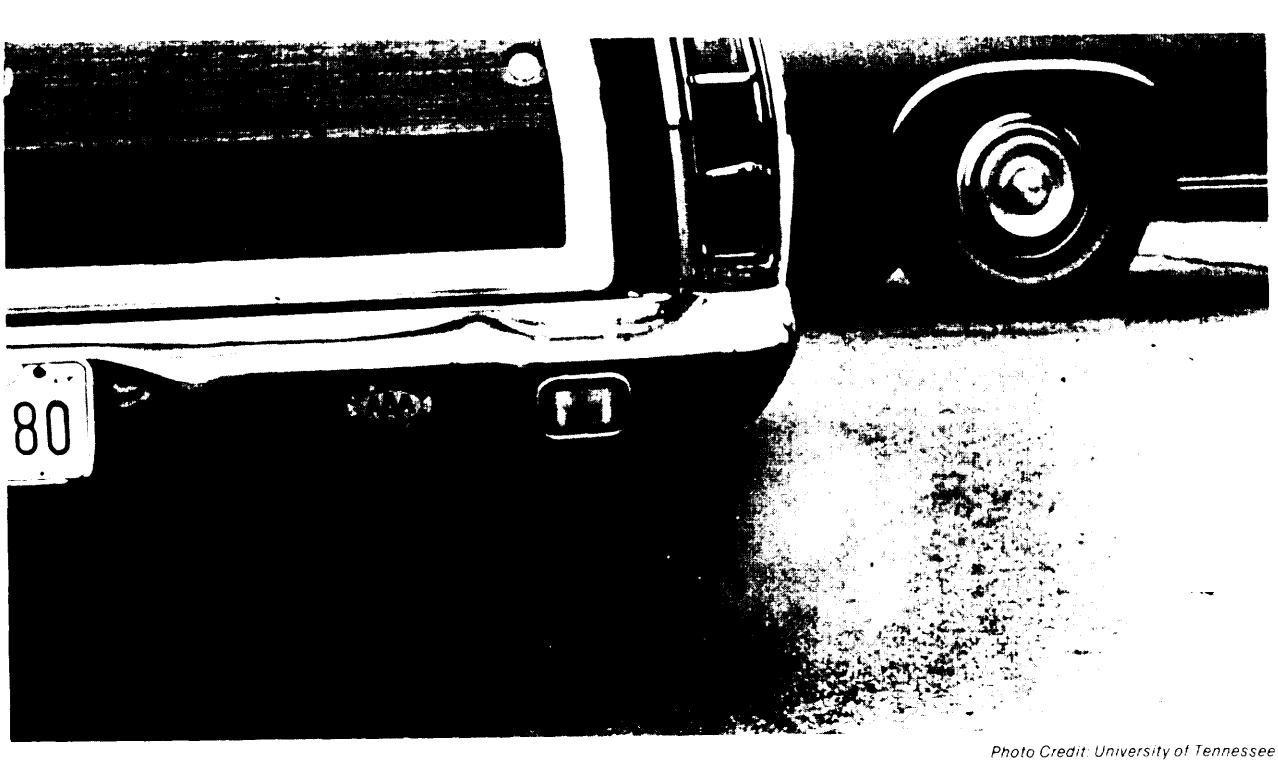

Photo Credit: University of Tennessee

. . . peak concentrations . . . often coincide with rush-hour automobile traffic . . .

forded by measures directed at stationary sources, the total reduction produced by a 0.4-gram-per-mile standard for automobiles would be rather small, and the cost per ton of NO_x removed would be much higher. Also, lowering the standard to 0.4 gram per mile by 1990 could preclude diesel engines, which currently emit 2 grams per mile or more of NO_x By 1990, the level of NO_x emissions from diesels might be reduced to 1 gram per mile, but probably not much lower—unless there is a major technological breakthrough. Elimination of diesels would, in turn, lead to a greater proportion of cars powered by conventional Otto-cycle engines in the new car fleet from 1990 to 2000. Such automobiles emit *more* hydrocarbons per mile than diesels. Our projections indicate that the tightening of new car NO_x standards could result in about **100,000** more tons of hydrocarbons per year from automobiles—an increase of 3 percent in comparison with the level of hydrocarbons expected under Base Case conditions.

Mandatory Inspection and Maintenance

This measure would involve a national program of annual or semiannual inspection of all cars, instituted with the cooperation of State and local governments. Vehicles failing to meet standards would be required to have adjustment, repair, or replacement of emission-control devices. It is assumed that inspection procedures would be limited to tests of CO and HC exhaust emissions since there is, at present, no practical test procedure for NO. emissions in general use.

It is projected that mandatory inspection and maintenance would reduce CO emissions by almost 17 million tons per year for the country as a whole in 2000. This would constitute a reduction of nearly 65 percent in automobile CO emissions and a reduction of 35 percent in CO from all sources. The reduction of HC would be less — slightly over 1 million tons per year in 2000, or 40 percent less than automobile HC emissions in the Base Case.

Mandatory inspection and maintenance thus appears to have great potential as a means to reduce automobile emissions. [5] However, a word of caution is needed about the magnitude of the projected effects. The benefits of inspection and maintenance depend heavily on esti-

[5] Inspection and maintenance could also produce important secondary benefits in terms of fuel economy and correction of safety defects.

mates of the deterioration rates of emission-control devices—oxidation catalysts and three-way catalytic converters. These devices have been in use for only a short time, and the data on their continued effectiveness over **.50,000** or 100,000 miles of actual driving are limited. Estimates made by the Environmental Protection Agency (EPA) during the period *1975-77* indicated that the performance of emission-control devices would be relatively stable *over* time and that they would lose no more than half their initial effectiveness after 10 years of use.

More recent data from EPA indicate that emission-control devices deteriorate at a more rapid rate than originally expected. For example, CO emissions from a vehicle certified as meeting a standard of **3.4** grams per mile when new are now estimated to increase to 10 grams per mile after 5 years **(50,000** miles) and 22 grams per mile after 10 years (100,000 miles). Similar sixfold to eightfold increases are estimated for HC and NO_x emissions after 10 years on the road without maintenance or repair of the emission-control system.

Thus, the benefits of inspection and maintenance are proportional to the assumed deterioration rates of emission-control devices and the assumed degree of correction that can be accomplished by maintenance. The findings presented here and in the Technical Report are based upon the most recent (1978) EPA data. If the EPA estimates are accurate, the benefits of mandatory inspection and maintenance would be very great, If, however, the EPA estimates are overly pessimistic and emission-control devices do not lose their effectiveness as rapidly as now believed, the benefits of inspection and maintenance would be lessened accordingly, although they still might be large enough to warrant imposition of a mandatory inspection and maintenance program. A full assessment of this policy must await more definitive information about the continued effectiveness of emission-control devices under actual driving conditions.

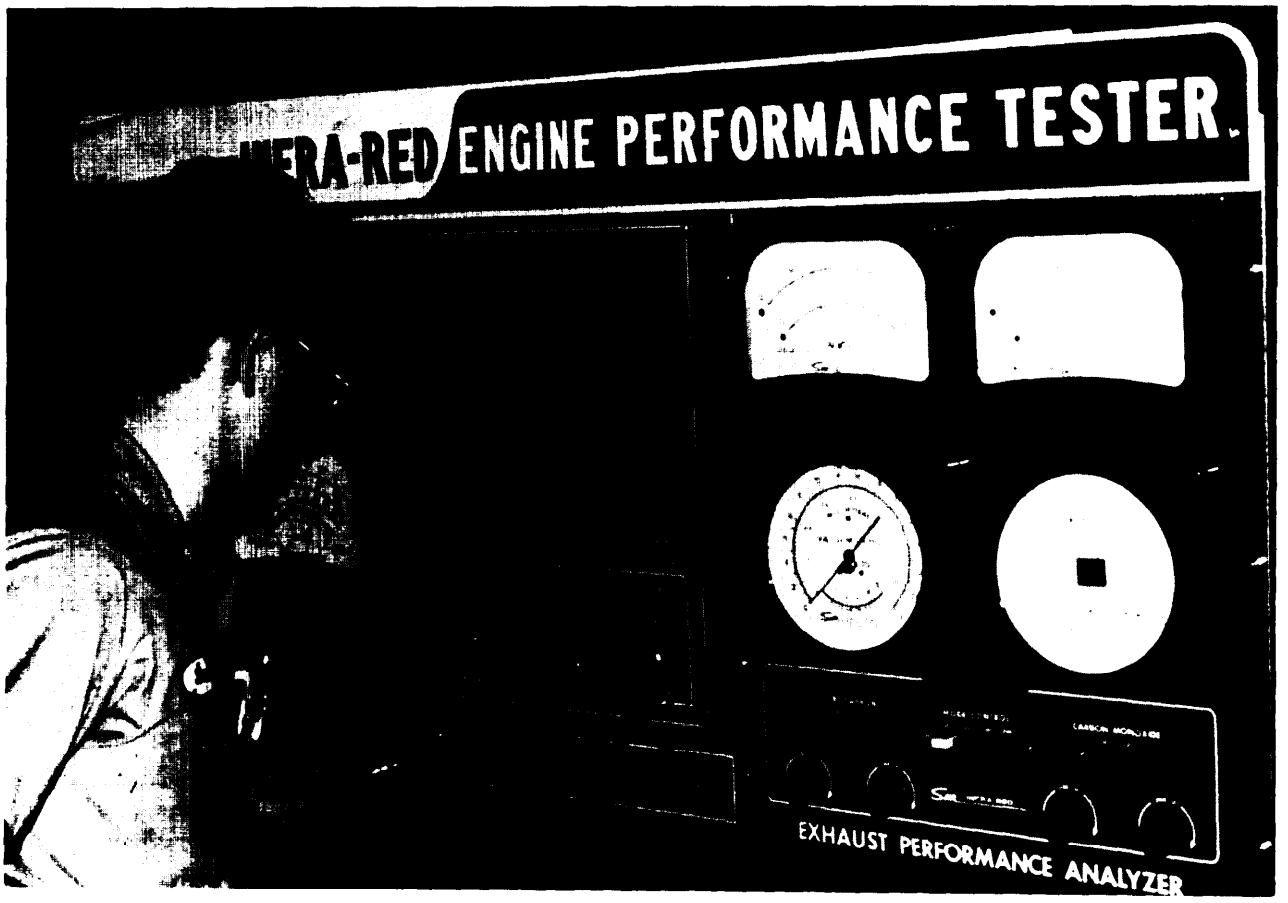

Photo Credit: University of Tennessee

. . . annual or semiannual inspection of all cars . . .

Changes in Automobile Emissions From Base Case Year 2000 (million tons)

Measures to reduce emissions	Carbon monoxide	Hydrocarbons	Nitrogen oxides	Particulates
Stricter NO_x standard	—	+ 0.098	-0.690	-0.199
Inspection and maintenance	-16.730	-1.040	—	—
Decreased auto travel (4 percent)	- 0.840	-0.164	-0.190	-0.007
Net	-17.570	-1.106	-0.880	-0.206

NOTE: COMPARISON OF MEASURES TO REDUCE emissions from automobiles indicates that major improvements could result from a nationwide program of inspection and maintenance. At present there is no test for NO_x in general use, and no inspection technique for NO_x was assumed for this comparison. Also indicated are the tradeoff penalties that could result from stricter NO_x emission standards. Decreased auto travel assumes improvements that could result from auto use disincentives and mass transit system improvements.

Control of Auto Use in Specific Locations

Air pollution is basically a localized urban problem, and we have examined approaches to discourage auto use in urban areas during rush hours. Possible measures that could be adopted are auto-free zones, restricted access by time of day or type of vehicle, and limitation of commuter traffic (either by tax or outright prohibition) except for multiple-occupancy vehicles. Automobile use could also be discouraged through restriction or elimination of parking in congested areas by means of parking surcharges, elimination of on-street parking, bans on parking for nonresidents, and limits on construction of new parking lots. Disincentives for "drive alone" commuting could include priority lanes and special parking for carpools and vanpools .

For such programs to be fully effective, it would also be necessary to improve public transit as an alternative mode of personal transportation and as compensation for the restriction of automobile use.

Environmental Impacts of New Technology

The advent of new technology for automobile propulsion systems and fuels raises the prospect Of new or more serious effects on the environment. Experience with the automobile has made us more alert to these possibilities, and the growth of environmental sciences has increased our ability to detect and forestal I these effects before environmental damage occurs.

One concern is the environmental effect of the growing use of diesel engines in passenger cars as a way of getting higher fuel economy. Diesels emit 2 to 4 times more NO_x per mile than spark-ignition engines, Diesels also emit more particulate. Results of an EPA research program on health effects indicate that diesel particulate emissions produce a strong mutagenic response under laboratory conditions and may be carcinogenic. Additional testing is needed before diesels can be given a clean bill of health.

There may also be major environmental impacts associated with the production of synthetic fuels from coal and oil shale. Air quality standards in regions of coal or oil shale conversion and refining might be violated. There will also be a need to assure that mining areas are adequately restored and that water pollution is prevented in the Western United States, where the bulk of mining and production would take place.

Liquid fuels derived from coal contain high levels of benzene (a known carcinogen). Gasoline contains approximately 2 percent benzene, while coal liquids can contain up to 10 or *15* percent. Measures to protect worker health and safety at coal liquefaction plants would be required. The benzene content of the fuel might have to be reduced before it could be used in motor vehicles.

Electric vehicles emit virtually no pollutants on the road. However, the extensive use of electric vehicles would create increased demand for electricity y, with a resulting increase in particulate, NO_2, and SO_2 emissions if the electricity came from coal-fired powerplants. Still, the net effect on the environment could be favorable since powerplants could be sited outside of urban areas and emissions from a point source might be more easily and economically controlled than those from multiple mobile sources.

FINDINGS

. Additional measures to control automobile emissions will be necessary to meet air quality standards in urban areas.

. Further tightening of new car emission standards— particularly for nitrogen oxides— would be only marginally effective.

. A nationwide program of inspection and maintenance of vehicles in use could produce substantial reductions in automobile emissions and consequent improvement in air quality.

. Control of automobile use would be effective as a supplementary measure in specific locations. However, as a general nationwide strategy, automobile use controls appear to be of limited value.

. The introduction of new technology for automobile propulsion systems and synthetic fuels may create new adverse impacts on the environment. Diesel particulate emissions are of special concern because of their possible carcinogenic properties.

. Projections of other environmental impacts of automobiles and highways— noise, community disruption, intrusion in recreational and wilderness areas, and disposal of scrap vehicles and parts— do not indicate the need for major new policies by the Federal Government. Present policies appear to be adequate.