

AUTOMOTIVE AIR POLLUTION

SUPPLEMENTAL REPORT

JOINT STATE GOVERNMENT COMMISSION

General Assembly of the Commonwealth of Pennsylvania

1967

The Joint State Government Commission was created by Act of 1937, July 1, P. L. 2460, as last amended 1959, December 8, P. L. 1740, as a continuing agency for the development of facts and recommendations on all phases of government for the use of the General Assembly.

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AUTOMOTIVE AIR POLLUTION

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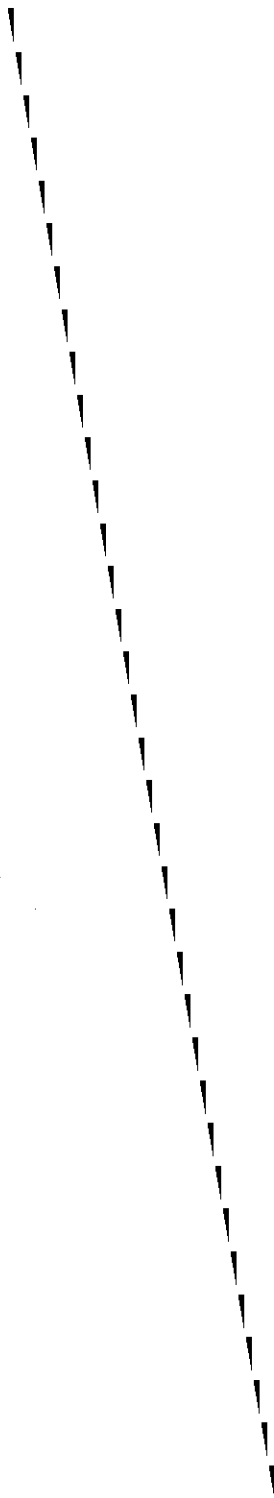
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LETTER OF TRANSMITTAL

To the Members of the General Assembly of the
Commonwealth of Pennsylvania:

In accordance with Senate Resolution No. 2, Session of 1962, which instructed the Joint State Government Commission to begin an “. . . investigation and study of the relationship of motor vehicle exhaust fumes to air pollution . . . ,” a report entitled *Automotive Air Pollution* was submitted in 1963 for the information of the members of the General Assembly. There is submitted herewith a supplement to that report.

The Supplemental Report is presented by Chairman N. R. Sparks, on behalf of the Commission's Panel of Technical Advisors on Automotive Air Pollution.

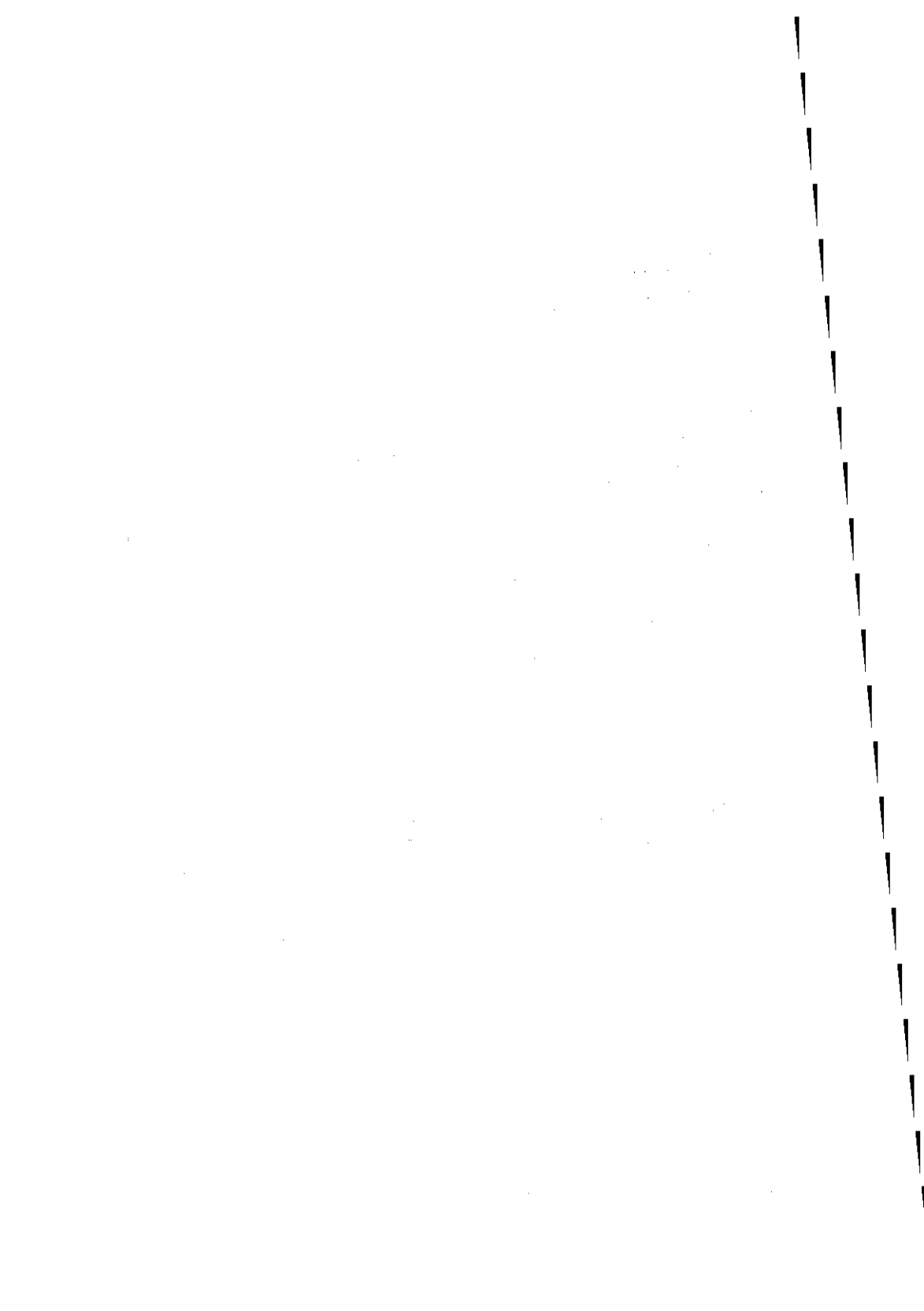
In specific, this report explains the present state of automotive air pollution control as approached by the Federal Government and by the automotive industry. More directly to the concern of this Session the report suggests four ways in which the General Assembly may effectively address itself to the problems at hand.

It is apparent from this report, as well as from concurrent studies by national, state, and local agencies, that automotive air pollution has become a major governmental problem in our urban mobile society. The health of our citizens and the preservation of property values require our best effort and initiative in this area.

I have the honor to present this report for your consideration and the responsibility to ask your urgent attention to its content.

MARIAN E. MARKLEY, *Chairman*

*Joint State Government Commission
Capitol Building
Harrisburg, Pennsylvania
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The Problem

There can be no doubt about the harmful effects of air pollution on human health and property. Growing awareness of the problem is indicated by the increasing furor in technical journals, in popular magazines, in the press, and on radio and television. Citizens' groups have been formed throughout the nation in an attempt to find ways and means of dealing with the worsening air pollution problem. Fortunately public officials in both the legislative and executive branches of government at the Federal and State levels are cognizant of the hazards of polluted air. It is from these leaders that action may be expected which will result, eventually, in the reduction of the danger of air pollution until it no longer poses a threat.

Of the air pollution present over the urban centers of the nation, an estimated 40 to 85 percent is due to motor vehicles, with the remainder originating in "stationary" sources. Because of the mobility of the automotive source and the technical problems involved, automotive air pollution is more difficult to control than pollution attributable to stationary sources. A mobile source is not amenable to local control such as those which may be effective in reducing pollutants from stationary sources. In fact it has been suggested that the state may be too small for effective automotive emission control and that interstate uniformity may be necessary to successfully attack the problem. This may be true, but at the present time it appears that individual states will have to take the lead in a sensible approach to any effective solution.

The Federal Government has promulgated certain regulations pertaining to automotive emissions which will be described later in this report. To date, these regulations offer the only prospect of relief for Pennsylvania. However, the Federal regulations are not enough. They require support from the Commonwealth in order to achieve decisive relief from the threat of ever-increasing pollution from mobile sources.

On February 5, 1967, the Department of Health, Education and Welfare announced a regulation intended to rectify *in new vehicles* the last of three important sources of emission. The Federal Government has thus finalized emission standards to which vehicle manufacturers are subject beginning with 1968 and 1969 model years.

In view of this completion of emission regulations by the United States Government, it is now possible to consider sensible measures which can be initiated by the states in support of the national program.

Such measures, together with explanatory material, are offered in the following pages of this report.

II

Why the Automotive Engine is a Source of Air Pollution

To begin with, the motor vehicle is powered universally by the internal combustion piston engine. These engines are of two types—the spark-ignition or gasoline engine and the compression-ignition or diesel engine. The gasoline engine predominates in the United States and it has such serious emission problems that it is a major influence in atmospheric pollution. These two types of engines have such different emission characteristics that they must be considered separately in any approaches to control the noxious, gaseous discharges.

The gasoline-powered engine is of such a nature that there is seldom, if ever, a sufficient amount of air supplied to completely burn the fuel; that is, it operates for maximum performance on so-called “rich” mixtures. This is inherent with the gasoline engine and results in unburned hydrocarbons and carbon monoxide being discharged from the engine. These constitute two of the most objectionable emissions. Also emitted are oxides of nitrogen, the result of high temperature combustion, and some compounds of lead added to the fuel to suppress detonation.¹ Moreover, the gasoline engine because of its discharge of hydrocarbons and oxides of nitrogen lays the foundation for the photochemical smog which plagues many communities and is the cause of eye, nose, and throat irritation, as well as reduced visibility.

The diesel engine, on the other hand, always operates with an excess of air and therefore the hydrocarbon and carbon monoxide emissions are relatively low. The principal objections to the diesel engine are the visible smoke and the odor which accompany its operation. These two characteristics are most objectionable to the public and give the impression that the diesel is the bad offender from the standpoint of air pollution. Actually, the diesel constitutes more of a nuisance than a threat and, while some control should be exercised, it does not have the same adverse effects on health and property as does the gasoline engine.

It should, therefore, be understood at the outset that it is the gasoline

¹For a more complete discussion see *Automotive Air Pollution*, A Report of the Panel of Technical Advisors on Automotive Air Pollution to the Joint State Government Commission, 1963, Appendix C.

engine which is the prime offender in polluting air, because of the character of its emissions and also because of the vast number of gasoline-powered vehicles compared to diesel-powered vehicles. Emissions per vehicle (see Section IV) may seem insignificant. It is not, however, the discharge per vehicle, but rather the collective emissions which are important in view of the very large number of these vehicles in operation in the United States.

Within the gasoline-powered vehicle there are three important sources of noxious gases. These are: (1) the gases discharged through the exhaust or tailpipe (approximately 60 percent of the total hydrocarbon discharge occurs here as well as carbon monoxide, oxides of nitrogen, and lead compounds); (2) the crankcase or "blow-by" gases (composed of hydrocarbons and lubricating oil mist which provide approximately 30 percent of the total hydrocarbon emission); and (3) evaporative losses (these result from the evaporation of gasoline from the fuel tank and from the carburetor. Both the fuel tank and the carburetor are vented to the atmosphere and, because of the volatility of the fuel, they both discharge a considerable quantity of hydrocarbons into the ambient air—some 10 percent of the hydrocarbon emissions).

III

Means for Reducing Pollution from Motor Vehicles

Theoretically, there are several other types of power plants which could be used to operate motor vehicles, and it is conceivable that the present type gasoline engine could be modified to produce almost emission-free operation. However, as previously pointed out, this engine inherently, because of lack of sufficient air, is a bad emission performer. Certain things can be done and are being done to reduce the discharge of these gases by consuming them more completely in or after they leave the engine.

Cycles have been developed, using gasoline as a fuel, to permit the use of excess air in order that the combustion may be complete or nearly complete. However, these have not gained any wide acceptance.

The gas turbine is often spoken of as an alternate for the present conventional engine. It would certainly produce almost no hydrocarbons or carbon monoxide in the exhaust because of the large amount of excess air used for cooling purposes. It should be recognized, however, that the gas turbine has other characteristics which are not well-suited for the propulsion of vehicles. And, even if this type of engine eventually proved to be technically feasible, its general adoption is a long way in the future and no dependence can be placed on it for any immediate relief from air pollution.

It is interesting to note that the old steam-power plant which was used, though limitedly, in automobiles until about 1928 would have produced little air pollution. However, the gasoline engine was developed rather than the steam engine because the latter had technical problems, particularly in steam generation, which could not be as readily solved as the problems of the gasoline engine.

It must be kept in mind that the development of any new power plant or even any radical modification of the present type of power plant is so interlaced with research and development, design and production, that nothing can be expected quickly or even in the very near future.

The electric car is coming back into the picture after a lapse of many years. It would be emission free, but whether the American public will accept this limited performance car were one successfully developed remains a question. The electric car has very limited cruising range and, therefore, would be largely restricted to commuter and urban service.

In terms of acceleration and speed, it cannot be expected to have the performance to which our public is accustomed; but it does have, with a range of some 80-100 miles before recharging, distinct possibilities for limited service. It would not be satisfactory for long-distance, cross-country cruising or for sustained high speed operation. Furthermore, even if the public could be sold to the extent that one car in 100 in our cities were to be electric, there would be but little improvement in the air quality. According to the best information available, the electric car is some five years away from near satisfactory mass production.

Futuristic power plants, like those utilizing nuclear energy, are so far distant that they will not be discussed here.

Thus, the internal combustion engine is probably here to stay for some time because of its advanced state of development and despite the drawbacks from the standpoint of air pollution control. The automobile manufacturers who will have to meet Federal emission standards will probably utilize the technology which was developed for 1966 model year cars sold in the State of California. By use of these systems, which are moderately satisfactory, the industries will be able to meet the Federal requirements. There are two general systems now developed for the reduction of emissions. One of these uses an engine-driven air compressor which injects air at the exhaust valve of each cylinder in order to burn the hydrocarbons and carbon monoxide which are discharged from the cylinders; the other system uses no compressor, but attains a low emission rate by means of a judicious variation of spark advance and a leaner-than-normal carbureted mixture. Both of these systems may be somewhat further developed and improved before the advent of the 1968 model vehicles, but neither is considered the ultimate in emission control.

Considering the large number of conventional cars now on the road and also considering the needs of new cars which will be developed, the most important ingredient at the moment is proper and periodic maintenance. Gasoline engines badly out of adjustment, or needing major repairs, operate with an emission rate many times higher than the same car would have if it were properly maintained. In this case it should be noted that any periodic maintenance procedures which might be recommended and adopted would not only keep emissions at a minimum, but would benefit the vehicle owner because of improved performance and fuel economy. This is true both of vehicles now on the road and all those to be affected by the new Federal regulations. In a comprehensive testing program on emission-controlled 1966 model cars, it was noted that a degradation emission-wise occurred after an average of approximately 12,000 miles of operation. It can be expected that this situation

will not change radically in the near future and, therefore, proper maintenance becomes most important in any program of emission control.

Experience suggests that legislation or the threat of legislation will continue to be the catalyst in reducing automotive emissions.

IV

Federal Legislation and Regulation

The most important present legislation which will affect Pennsylvania is the Federal Clean Air Act, passed by the Congress in 1963 and amended late in 1965. This act, as amended, besides providing for financial assistance to areas with sound air pollution abatement programs, authorizes the Secretary of Health, Education and Welfare to set emission standards for all gasoline-powered cars and light trucks. Accordingly, the Secretary of Health, Education and Welfare has promulgated two sets of regulations. The first regulation affecting motor vehicle emissions was published under date of March 30, 1966.² This regulation set emission standards for new cars beginning with the 1968 models which restrict the concentration of hydrocarbons and carbon monoxide from the exhaust to 275 parts per million of hydrocarbons and one and one-half percent by volume of carbon monoxide. These limitations are placed on gasoline automotive engines in excess of 140 cubic inches piston displacement. This includes all American-made cars and some foreign-built vehicles. Smaller engines are permitted higher proportions of hydrocarbon and carbon monoxide. From the mass standpoint these smaller engined imports will be almost insignificant. The regulation further stipulates that no crankcase gases shall be discharged into the ambient atmosphere. This means that not only will factory installed crankcase ventilation systems have to be used, but they will have to be totally effective. These two regulations eliminate all of the hydrocarbons discharged from the crankcase and will drastically reduce the pollutants in the exhaust. This can be illustrated by the fact that the average car in California is estimated to have an emission rate of approximately 1,000 ppm of hydrocarbons and almost 5 percent carbon monoxide in the exhaust.

A new Federal regulation just announced on February 5, 1967, will limit the third source of emissions, evaporative losses, beginning with 1969 model engines. It is expected that about 90 percent of this source will be controlled.

It should be pointed out that while the new Federal regulation will affect new vehicles as delivered, the United States Government, at

² *Federal Register*, Vol. 31, No. 61, Part II.

present, has no enforcement procedure which will guarantee that such vehicles remain satisfactory over a period of time. It appears, therefore, that those states which wish to maintain the low emission rates on new cars will have to have some form of regulation which will insure that the cars sustain their good performance from the standpoint of emissions. This will involve the problem of periodic maintenance previously mentioned.

Recommendations

In discussions covering the study of the problem of motor vehicle air pollution over the past five years, the Panel decided early that it would not recommend measures or programs which would involve the State in undesirable and ineffective activities or superficial solutions. It has also been an aim of the Panel not to suggest regulations of such a complicated or radical nature as to be ineffective or nonenforceable.

It might be profitable to mention briefly, first, actions which are NOT recommended. These are:

(1) Any "crash" program. The ultimate solution should be recognized as a relatively long-term project. No radical legislation will provide an overnight cure, but will produce confusion and resentment without commensurate relief.

(2) The setting of emission standards. This would be unenforceable, because it would require the checking of all vehicles periodically. Such checks would require the establishment of a large number of stations equipped for the purpose as well as a means of remedying the situation in vehicles failing to meet these standards. Exhaust analysis requires not only proper instrumentation but a dynamometer to permit uniform testing under various modes of operation. It is impractical to expect a large number of stations to make the necessary investment for this purpose. Furthermore, such a check would be only for exhaust emissions and would determine nothing concerning the operation of blow-by devices.

(3) Any program which would involve the Commonwealth in the business of testing and approving emission control devices. This would be costly and complicated and highly unprofitable when viewed in the light of a questionable reduction in mass emissions from motor vehicles throughout the state.

(4) Any regulation requiring the installation of emission control devices in used vehicles which were not so equipped at the factory. This has been attempted elsewhere and has proved to be generally unsuccessful owing to improper installation, lack of maintenance, and general noncompliance by vehicle owners.

What may be and should be done by the State is to introduce a moderate program in support of Federal regulations. These regulations

at present insure only that the new vehicle purchaser will receive a product which is capable of sufficiently low emissions to meet national standards, beginning with 1968 models. It is known that the normal 1968 *et seq.*, models will suffer a degradation in emissions after a period of operation—probably about 12,000 miles on the average. This corresponds fairly closely to the average annual mileage. Periodic maintenance is, therefore, the key to continuing low emissions for these vehicles.

Vehicles preceding 1968 will have varied emission characteristics. These older vehicles will gradually phase out and should be permitted to do so without required structural change. However, maintenance is again the important factor here and should be required periodically so as to lower discharges to the minimum of which a particular vehicle is capable.

Bearing in mind the above mentioned pitfalls which the Panel has long recognized as highly undesirable for incorporation in any responsible recommendations, there now remains to be determined what *may be* done to establish a constructive State program dealing with the problem. Whatever regulations are adopted, they should be subject to review and possible change in view of national measures advanced by the automotive industry or by the Federal Government. For example, there are likely to be, eventually, regulations governing the emission of nitrogen oxides in addition to the present restrictions on hydrocarbons and carbon monoxide. This will come about when it is technically feasible to control these noxious gases. Or, it may be found desirable to modify or to strengthen a program after it has been in effect for some time. In other words, any program which is undertaken should not be considered inflexible, but, on the contrary, should be capable of ready amendment in order to conform to progress in the field.

At the present time, the air pollution originating with the motor vehicle is virtually uncontrolled in Pennsylvania. The Federal regulations previously described will begin with 1968 model vehicles and will require State support for continued and increasing effectiveness. With a temporary lull in the enunciation of emission standards by the National Government, the time is propitious for the initiation of a State program.

In proposing the following course of action, a great deal of consideration has been given to the points discussed above as well as to the desirability of keeping such an emission-control program of minimum net cost to the vehicle owner while at the same time assuring progress over the period of the next few years. State support of increasing national participation in this campaign is of paramount importance. This plan while being suggested specifically for Pennsylvania could be

profitably used by other states which do not have special automotive pollution problems. It is proposed that the program be put into effect by January 1, 1968, if possible. The program should embrace the following four points:

(1) A maintenance (or AP) inspection system should be inaugurated for all gasoline-engine-powered vehicles registered in the State. This would be compulsory on an annual basis at the end of each year of vehicle age. It would encompass the following: (a) an engine tune-up in accordance with the manufacturer's specifications; (b) a compression test on all cylinders as a quick and simple means of detecting faulty piston rings and/or valves. Vehicles failing to meet manufacturers' standards would be required to undergo remedial repairs; and (c) an inspection of emission-control devices on vehicles so equipped, with repairs as necessary.

Stations which would perform these operations should be carefully selected, possibly from among the presently authorized inspection stations, on the basis of their qualifications to satisfactorily carry out these functions.

(2) It should be unlawful to operate any gasoline-engined vehicle, under the jurisdiction of the State, with continuous visible emissions, other than water vapor, from either the exhaust or from the crankcase—violators to be required to make remedial repairs.

(3) Diesel-powered vehicles should be limited in smoke density from the exhaust in accordance with standards to be established by the appropriate State agency. Properly designed engines showing dense smoke are either overloaded or in need of servicing. The cause should be remedied.

(4) The removal of emission-control devices or otherwise tampering with such devices in order to render them inoperative should be forbidden. This applies to vehicles so equipped by the manufacturer.

