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The Auto Industry and the Environment

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The quality of our natural environment has become an issue of crisis proportions. We are told that pollution threatens our lifestyle, our health and our very existence. Attaining and maintaining a quality environment is challenging our technology, taxing our resources and subjecting our will, values and understanding to an unprecedented test.

The environmental crisis is part of the backwash from our nation's rising living standards, its mounting energy requirements and its growing population. It reflects the fact that our affluent society has simultaneously become an "effluent" society.

Our society's new awareness of pollution results not only from the undeniable growth of the problem, but also from the new availability of information and publicity on the general subject. Furthermore, Americans who are proud of our ability to put men on the moon and isolate the gene find it difficult to understand why our technology and resourcefulness do not provide instant answers to such challenges as restoring purity to our waterways or clarity to our skies.

There is no doubt that many aspects of the ecological situation are alarming. On the other hand, the hysterical approach of some environmentalists will only make the problem harder to solve. Their emotional insistence on instant solutions has helped obscure the practical difficulties involved in dealing with the problems and has, in fact, made thoughtful opposition to jerry-built remedies often seem like heresy or worse.

What has long been lacking in assessing the pollution problem has been any kind of agreement on essential goals and priorities. We need to know, first of all, which pollutants represent the greatest hazards. And we need to establish rational priorities for

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pollution control based on the seriousness of the problems and the cost effectiveness of available solutions. Precisely because the environmental crisis is so urgent, we cannot afford, as a nation, to waste time and money on ineffective efforts or on the less serious aspects of the problem.

Society cannot depend on the competitive forces within a free market to generate the action necessary to control pollution. Not enough car buyers, for example, will volunteer to pay the extra cost involved in providing expensive emission control devices for their cars. It is therefore necessary to have effective government regulation to guarantee adequate and uniform response by buyers and sellers alike to social needs of this kind. Government standards are needed to prevent the company that spends nothing for pollution control from having an advantage over its more conscientious competitors.

Thus there is a key role for law to play in setting and maintaining standards for pollution control. With the recent establishment of the federal government's Environmental Protection Agency, the United States should now be able, for the first time, to mount a coordinated, objective and scientifically based effort to isolate, quantify and eliminate a wide variety of pollutants. But it is equally important that government, as the guardian of standards, not be stampeded into hasty actions which may turn out to be ineffective or directed against the wrong problems. The heart of the pollution problem still remains a matter of definitions, measurements and priorities.

Whatever their differences in outlook, government and industry have the responsibility to ensure that the benefits to the public of pollution control regulations are commensurate with the costs which the public ultimately must bear. Industrial management has an obligation to support and encourage sound regulations, while government has an obligation to establish priorities based on technological and economic feasibility and on the cost effectiveness of the available remedies.

Motor Vehicle as a Source of Air Pollution

The automobile was first identified as an important source of air pollution in Los Angeles in the 1950's when the relationship
between vehicle emissions and photochemical smog formation was established.

Air pollution is an extremely complex phenomenon which is still not clearly understood. There are many sources of air pollution, including nature, and many different kinds of pollutants some of which are more harmful than others. Pollutants may combine with each other with various effects depending in large part upon the weather and local topography. Good information about the harmfulness of different pollutants and combinations of pollutants is still scarce.

Public discussion of air pollution often focuses on the allegation that automobiles are responsible for most of the total tonnage of all man-made pollutants. This is not correct. The most recent analysis by the Department of Health, Education and Welfare [H.E.W.] shows that motor vehicles contribute less than 40 percent of the total man-made tonnage. More important, this gross measurement is not particularly meaningful because it ignores differences in the harmfulness of different pollutants.

Rational and efficient air pollution abatement programs must be directed not toward vaguely defined goals such as achieving "pure" air, but at solving particular, identified air pollution problems. Several such problems have been identified, and they appear to be confined mainly to large cities.

Automobiles, according to the H.E.W. findings, contribute about 60 percent of the man-made carbon monoxide in the United States. Industrial processes, solid waste disposal, forest fires and other types of burning account for the balance. Carbon monoxide, of course, is highly toxic in sufficient concentrations. It is transformed into carbon dioxide by natural processes, however, and does not remain indefinitely in the atmosphere. We have found no evidence that carbon monoxide is harmful to health even in the highest concentrations reported in the out-of-doors atmosphere, although such concentrations may lead to temporary slowing of reaction time.

Automobiles, according to the same H.E.W. figures, also contribute about 49 percent of the man-made hydrocarbons and 35 percent of the man-made oxides of nitrogen. Industrial processes and such miscellaneous causes as forest fires and organic evapora-
tion of solvents account for the balance of man-made hydrocarbons in the atmosphere, while fuel burning from stationary sources is responsible for almost 50 percent of man-made oxides of nitrogen. Under certain atmospheric conditions, hydrocarbons and oxides of nitrogen combine in the presence of sunlight to form photochemical smog, which impairs visibility and is irritating to the eyes and respiratory tract. Photochemical smog occurs most frequently and severely in the Los Angeles basin. Solving this problem clearly requires control of both motor vehicle and stationary source emissions.

In most cities, sulfur oxides and particulates constitute the major air pollution problems. Sulfur oxides may react in the atmosphere to produce weak but corrosive concentrations of sulfuric acid. Air pollution from particulates is extremely complex because of their wide range of size and chemical composition. Particulates reduce visibility, may play a role in the formation of atmospheric smog, may affect weather locally, and eventually settle out as dust or soot which dirties objects on the ground.

It is important to note that it was a combination of a high concentration of particulate matter and sulfur oxides, along with unfavorable weather conditions, that was responsible for the infamous 1952 London "killer fog" in which 4,000 people died. The same is true of incidents in Donora, Pennsylvania, in 1948 and in Belgium in 1930.

However, motor vehicles contribute only about 1 percent of sulfur oxides and 3 percent of particulates. Virtual elimination of lead additives from gasoline will substantially reduce exhaust particulates. It is clear, therefore, that efforts to solve the air pollution problems which are associated with these pollutants must focus on control of emissions from stationary sources.

A rough indication of the overall relative importance of motor vehicles as a source of air pollution problems is provided by weighting the gross tonnage of the various pollutants to reflect a judgment about their relative harmfulness. Professors Sawyer and Caretto of the University of California developed a procedure which reflects California ambient air quality standards, and concluded that the automobile is responsible for only 12 percent of the national air pollution problem. This is so because motor
vehicles are a minor source of the most troublesome pollutants: sulfur oxides and particulates.

Because of uncertainty about the effects of various pollutants, alone and in combination, the quantitative validity of this conclusion is open to question. Even allowing for substantial inaccuracy, however, it is clear that control of motor vehicle emissions, although necessary, is not, by itself, a cure for air pollution. A balanced approach to control all sources is essential.

VEHICLE EMISSION STANDARDS AND CONTROLS THROUGH 1973

Hydrocarbons and carbon monoxide were identified first as important automotive pollutants, and these compounds were the first to be controlled.

About 20 percent of the hydrocarbon emissions from an uncontrolled car come from the crankcase. The first emission control device was the crankcase ventilation system which eliminated practically all emissions from this source. This system was first made available in California in 1961 and throughout the country in 1963. A refinement to close the system and make it completely effective has subsequently been adopted nationwide.

About 60 percent of the hydrocarbon emissions and virtually all of the carbon monoxide emissions from an uncontrolled car come from the exhaust. Exhaust emission controls were first required on 1966 models in California and a supplemental air injection system was employed by Ford. In 1968, an improved combustion system was adopted nationwide on most Ford engine applications to meet federal standards.

The other 20 percent of hydrocarbon emissions result from fuel evaporation from the carburetor and fuel tank. Evaporative controls were required on all 1970 model vehicles sold in California and are required on all 1971 models nationwide.

With the application of these three kinds of control systems, a reduction of 70 percent in carbon monoxide emissions and 83 percent in hydrocarbon emissions has been achieved.

Although it has been known since the 1950's that nitrogen oxides are involved in smog formation, early experiments suggested that decreases in hydrocarbons alone would be sufficient to reduce smog. Initial vehicle control standards did not include
nitrogen oxides. The complete air chemistry of smog is not yet fully understood, but most recent studies have indicated that it is necessary to control both hydrocarbons and oxides of nitrogen in order to reduce smog. California has a nitrogen oxide standard of 4 grams per mile for 1971 models and will tighten it further in 1972 and then again in 1974. A federal standard for nitrogen oxides will become effective in 1973.

Control of the substantial stationary sources of nitrogen oxides is also essential. Motor vehicles contribute 35 percent of nitrogen oxide pollution nationally, and much less than that in some cities. In New York City, for example, stationary sources are responsible for five-sixths of the total. Controlling nitrogen oxide emissions from vehicles, therefore, would still leave substantial quantities in the air. Some progress in controlling stationary sources has been made, especially in the Los Angeles area.

While the hardest part of emission control still lies ahead, the measures already taken have effectively broken the back of air pollution problems attributable to the automobile. As a result of the steps described above, total motor vehicle hydrocarbon emissions into the air are now about six percent below those of one year ago. Total carbon monoxide emissions have declined about seven percent from last year at this time. These gains have been made and will continue despite the growing number of vehicles on our highways as vehicles without controls are steadily replaced.

**Automotive Emission Controls in the Future**

There is no disagreement over the need for additional reductions, but there has been great controversy during the past year over how much additional reduction is needed, how much is possible and how long it will take.

Three-and-a-half years ago, we at Ford recognized that we could no longer plan merely to develop lower-emission cars, but that we would have to develop essentially pollution-free cars. As a major part of our effort to achieve this goal, we joined with Mobil Oil Corporation and later with five other oil companies and four foreign auto manufacturers to establish the Inter-Industry Emission Control [hereinafter IIEC] program. The aim of this program has been to find the best combination of engine design,
exhaust control system design and fuel composition to minimize automotive emissions.

When this program was established, there were no governmental goals to tell us how clean an essentially pollution-free car would have to be. We had to establish our own goals. The goals we selected were based on what would be necessary to solve vehicle air pollution problems in Los Angeles—the city with the worst vehicle emission problems in the nation.

For hydrocarbons and oxides of nitrogen, we picked goals that would restore air quality to the level of 1940—before Los Angeles had a smog problem—and would maintain that quality through the year 2000 in spite of projected increases in vehicle use. For carbon monoxide, the IIEC goal was selected to achieve the desirable air quality level established by the state of California and, again, to maintain this level through the year 2000. These goals called for emission reductions of 90 to 97 percent from the levels of uncontrolled cars.

The validity of our judgment was later confirmed when the state of California announced its goals for a smog-free car by 1975, and again early last year when the Department of Health, Education and Welfare announced its tentative emission standards for 1975. Our own IIEC goals were more stringent than both the California and the federal goals for 1975 with respect to two out of three of the main automotive pollutants.

The IIEC program has explored and developed a variety of approaches to emission control—thermal reactors or "afterburners" to control hydrocarbons and carbon monoxide, exhaust gas recirculation to control oxides of nitrogen, and catalytic converters to control all three pollutants. Although efforts were made to develop systems that would function with leaded fuel, it was concluded that none of these systems would have satisfactory durability unless all lead was removed from gasoline. To make these IIEC systems work, it was also necessary to develop a variety of auxiliary equipment, including air metering controls and small computers to regulate fuel metering and spark timing.

The IIEC program has met its goals, both in the laboratory and in experimental vehicles, but the emission control performance of IIEC systems after many thousands of miles of use has not yet been fully tested. Beginning early in 1971, we began 50,000 mile
road tests of cars equipped with complete IIES systems to determine their durability and suitability for everyday use.

Later this year, we plan to offer several hundred experimental, low-emission vehicles incorporating results of our IIIEC and other research for sale to private and governmental fleet operators providing that federal air pollution control authorities will permit us to do so. We will also lend some of these vehicles to environmental control authorities in California and Washington for their evaluation.

We are optimistic about the outcome of these tests. Based on the results to date, we believe we could produce cars in 1975 that would not only meet the IIIEC goals but also satisfy the original 1975 California and federal emission level requirements.

Although it represents great progress, that achievement is no longer adequate. Recent amendments to the Clean Air Act now impose emission standards for 1975 that are more than twice as stringent as those previously proposed by California and H. E. W. The heart of the legislation is a requirement for a 90 percent reduction by 1975-76 in auto emissions from the 1970-71 levels. As noted above, the emission levels of our 1970 vehicles already represent 70 and 80 percent reductions for carbon monoxide and hydrocarbons, respectively. Consequently, the new standards require a total reduction of 97 percent for carbon monoxide and 98 percent for hydrocarbons from the emissions level of cars not equipped with controls.

An equally demanding feature of the law provides that as soon as suitable test equipment is available, manufacturers must warrant that their vehicles will comply with emission standards for five years or 50,000 miles. Because of unavoidable production variations and deterioration during use, this latter requirement means that the average car we produce must have emissions very substantially, perhaps as much as 50 percent, below the level specified by the standards. To date, we have been unable to hand-make a single vehicle approaching this level. We are, however, making steady progress.

By combining all of the different kinds of experimental emission control systems in a single vehicle, we have been able to conduct a few tests with results that—at a very low mileage—barely meet the new standards, as we interpret what those standards
probably will require. In spite of this progress, many difficult problems still must be solved (and in very little time) before it will be possible to meet the new standards.

1975 may seem a long way off, but the time between now and then is all too short compared to the work that still needs to be done. As of January 1, 1971, the beginning of 1975 model production was only three-and-a-half years away—not five. The beginning of durability testing required for 1975 model emission certification was then less than three years away. Major tooling procurement for 1975 models was only two years away. Decisions on basic vehicle package dimensions to accommodate 1975 emission systems were only a few days away.

Although the task will be difficult and may prove impossible, we will do our best to meet the standards and timetable enacted by Congress. We will come as close as we can as soon as we can. We can do no more, and we should do no less. Our first responsibility as a corporate citizen is to obey the law.

Other Aspects of the Vehicle Emissions Problem

Almost as important as the development of emission control devices themselves, has been the creation of devices and equipment to permit the quick and accurate identification and measurement of auto emissions as they come out of the exhaust pipe or exist in the air.

In conjunction with Honeywell, Inc., Ford Motor Company has developed an effective and simplified measuring system to detect when a vehicle is emitting excessively at idle speed as a result of improper engine maintenance or adjustment. This device is also helpful in tuning cars for low emissions. We believe it can play an important part in helping the motoring public to obtain the full benefit of vehicle emission control equipment. A test program we conducted with the federal government at Cape Kennedy showed that carbon monoxide emissions were reduced by an average of 28 percent when cars equipped with factory-installed emission control systems were properly tuned. Currently Ford Motor Company is conducting field tests with Indiana and New Jersey state agencies to explore the desirability of using the Ford/Honeywell measuring unit for quick engine checks in conjunction with state safety inspections.
More recently, Ford research has developed an emission optical detector which provides, for the first time, a fast, reliable and accurate means of measuring ozone, nitric oxide and nitrogen dioxide—three important but elusive ingredients in photochemical smog. Thanks to a coordinated research effort between scientists from Ford and the Department of H.E.W. (whose environmental functions have now been assumed by the Environmental Protection Agency) the optical detector can also measure total oxides of nitrogen emissions from vehicle exhausts.

The new optical detector is seen as having three potential uses. It can be used to monitor nitric oxide, nitrogen dioxide and ozone levels in the atmosphere at concentrations as low as one part in a billion. It will be used in our laboratories to help develop vehicles with lower oxides of nitrogen emissions. We are also hopeful that the federal government will adopt it as its standard instrument in certifying new models for compliance with standards for oxides of nitrogen emission. We have donated one of these devices to the Environmental Protection Agency and a second to the California Air Resources Board.

Reduction of vehicle emissions depends upon fuel composition as well as on engine and emission system design. Early in 1970, I wrote to the heads of major U.S. oil companies informing them of our conclusion that vehicle emission control systems to comply with 1974 and 1975 standards would also require that lead-free gasoline be available widely throughout the country.

Following extensive discussions with oil company representatives, we announced that virtually all of our 1971 models would be designed to operate on 91 octane fuel. Presently, some 90 percent of our current model production can operate on 91 octane fuels with the balance to follow at the beginning of the 1972 model year.

Much publicity and public interest have been generated in the past decade by proposals for new vehicle power sources that would not contaminate the atmosphere. Ford Motor Company engineers and scientists are exploring a wide range of alternative power sources. Although further refinement of the internal combustion engine still offers by far the most promising outlook for achieving virtually emission-free vehicles as soon as possible, we are pushing ahead vigorously with our efforts to develop other
vehicle power sources. Several of our development programs appear encouraging.

Ford Motor Company's work on gas turbine engines has advanced to the point that commercial production of such units will begin in August, 1971. While initial output of these turbines will be for stationary industrial uses, we expect to begin commercial production of turbine engines for long distance trucks and buses by 1975.

The possible use of turbine power in passenger cars depends largely on finding practical solutions to two major problems. First we still lack a combination of materials and manufacturing processes to produce turbine components that will be sturdy enough, especially at the high temperatures encountered in turbine engines, dependable enough and still inexpensive enough for use in passenger cars. Secondly, we are still unable to reduce oxides of nitrogen emissions from these engines to levels to be required by future standards. We are, however, making headway toward solutions to both of these problems.

Our research in electric cars is also moving forward. Ford scientists have at last solved the materials problems that have retarded development of the sodium-sulfur battery invented in our laboratories several years ago. Although the concept still faces some formidable engineering problems, we expect to make faster progress in the next few years and we are encouraged by the interest now being shown by several English, Japanese and European companies in sodium-sulfur battery development. At the same time, we are making progress in the development of lighter, more efficient electric motors of sufficient power for use in motor vehicles.

On the basis of our present experience, it appears that electric cars, at best, will be suitable only for relatively short-range urban and suburban use. Moreover, as long as most electric power is generated by burning fossil fuel, any switch from gasoline to electric-powered cars might only serve to increase rather than decrease air pollution problems.

There are encouraging developments too in the program we are conducting with Thermo Electron Corporation on Rankine-cycle engines. It now appears possible to use an organic non-
flammable liquid as the working fluid in this engine, thus elimin-
ing a source of possible fire hazard in case of accidental leak-
age. Small versions of this engine have very good emissions per-
formance but we do not yet know what problems we may en-
counter in scaling these models up to full passenger car size.

Disposing of Junked Cars

The challenge of solving vehicle-associated pollution does not end with our efforts to achieve emission-free cars and trucks. The problem of how best to dispose of an annual fall-out of some six million old cars and trucks has in itself become a separate and major environmental challenge. The problem results from the in-
ability of the scrap market to reabsorb profitably all of the vehicle hulks abandoned on city streets, stored in speculators' pastures or retained in backyard or vacant lots for parts scavenging.

The accumulations of old vehicles is an esthetic blight and a waste of natural resources. Part of the problem is found in the fact that these hulks are spread over such wide areas that it is frequently impractical and uneconomical to transport them long distances to processors and wrecking yards.

Despite these difficulties, substantial progress has been made. For example, Ford Motor Company has been involved in the con-
struction and operation of two fragmentizing mills in Michigan and Ohio to absorb scrapped vehicles and reprocess their metal for re-use in the production cycle. New approaches to vehicle re-
cycling are apparently having an effect. The most recent Depart-
ment of Commerce statistics indicate that in 1968 some two mil-
lion more cars were processed than were retired from service. This means that at least a dent has been made in the stockpile of old junked vehicles.

Our interest in encouraging the development of reprocessing systems stems from a conviction that it is far better to rely on the economics of the scrap market to draw old cars and trucks into the reclamation cycle than to resort to special vehicle "burial" bount-
ties and disposal incentive fees levied against a vehicle's first owner or its manufacturer. However, when normal supply and demand fail to stimulate the movement of junked cars into the scrap cycle, legislation may be necessary by individual states to
impose a small addition to the annual registration fee to provide
funds to encourage junk car disposal.

Pollution from Manufacturing Plants

In common with many other industries, we share the complex
problem of reducing air and water pollution and disposing of
solid wastes from our manufacturing operations. This year Ford
Motor Company will spend $45 million on facilities and equip-
ment for plant pollution control programs.

The problem of eliminating pollutants from the stacks of ex-
isting factories is always difficult, generally expensive and some-
times virtually impossible. Greatly accelerated efforts are being
made toward finding effective "fixes" for existing plants, an ex-
ample of which is a project Ford has under way with Koppers
Company. Its objective is to develop equipment to provide better
emission control at all three stages of the coke-making process—
when coal is fed into the ovens, during the coking cycle and when
the coke is pushed from the ovens. Our hope is that this project
will cut particulate discharges by 85 percent and will make Ford's
229 coke ovens the cleanest in the world.

There is a new urgency, too, in the search for new processes
which offer lower emissions among their advantages. The Pilkington
float glass manufacturing process installed in our Dearborn
and Nashville plants is a good example. By pouring molten glass
onto the surface of molten tin, we have eliminated the former
grinding and polishing operations and the serious water pollution
problem which accompanied these operations.

Generally, however, the most effective approach to eliminating
air pollution from stationary sources is to anticipate the problem
and build preventive or control equipment into new facilities. Pol-
lution control was a basic consideration in our planning for a new
casting facility we are now building near Flat Rock, Michigan.
We expect that its electric arc furnaces and emission control sys-
tems using dry fabric filters will make it the cleanest as well as
the most modern facility of its kind in the world. The cost of the
new casting center's pollution control systems alone will be some
$22.5 million.

Thanks to new waste water treatment facilities recently con-
structed and placed in operation at five U.S. and Canadian plants, Ford will keep its pledge to meet established water quality standards by the end of 1971. As part of that commitment, the Company is currently working with and supporting units of government in several localities to establish joint water collection and treatment facilities which will ultimately permit us to discharge treated industrial wastes into municipal or area sewerage systems when they are completed. The taxpayer, industry and the environment are all winners in this kind of cooperative, cost-reducing development of local waste disposal facilities.

This pattern was first established in 1968 at our new Kentucky Truck Plant. Unfortunately, the government agencies involved were not able to complete supporting facilities on schedule resulting in the premature downstream discharge of pollution from the Kentucky plant. This difficulty has now been overcome and the facilities are working as planned.

During the past year, Ford has intensified its search for cleaner methods of disposing of other non-salvageable solid and liquid wastes from our manufacturing plants. At our Rouge facility in Dearborn, Michigan, a new waste salvage and compaction plant has been built and placed in operation. Instead of burning many of our solid wastes as formerly, we now bring them to the new plant where re-usable materials are salvaged. The remaining wastes are shredded and compacted for economical transport to a land-fill location.

We have recently concluded a new agreement to sell tons of used wood, cardboard and waste paper from our operations to a national paper manufacturer instead of burying or burning them as refuse.

**CONCLUSION**

Public awareness of the environmental crisis and concerted national effort to restore and protect the quality of the environment are long overdue.

Although pollution is caused by each of us, by its nature it is a problem that can be solved only through the combined effort of government and industry.

Pollution is not one problem, but many problems. To improve the environment requires that the separate problems be identified
and solutions for them be developed. We must know what the major hazards are and what can be done about them. We must develop a system of priorities that tell how to spend our money to get the greatest possible results in the shortest possible time.

Improving the nation's physical environment involves complex engineering, scientific, economic and political problems. They are not the kinds of problems that can be solved effectively through litigation. The primary responsibility, therefore, should fall on legislatures to provide the statutory basis for regulation and on administrative agencies which have sufficient authority to respond flexibly to new knowledge and new technology.

To carry out these responsibilities effectively is as great a challenge as the executive and legislative branches have ever faced. To succeed, they will need to develop a new order of technical competence and a firm determination to respond more to scientific evidence than to political opportunity. They will need to develop a new ability to analyze the results of their activities, to acknowledge mistakes and to abandon programs which prove ineffective.

To succeed, they will also need the cooperation of industry. Industry has most of the knowledge and technical competence needed to solve pollution problems. It has an obligation to cooperate with government and to help government to develop sound legislation and to make sound administrative decisions. Given the realities of competitive markets, industry should do as much as it can rather than as little as it must.