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Report on Air Pollution Control Policies in the Portland Airshed

City Club of Portland (Portland, Or.)
REPORT

ON

AIR POLLUTION CONTROL POLICIES IN THE PORTLAND AIRSHED
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Report on
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To the Board of Governors,
City Club of Portland:

I. INTRODUCTION

A. Charge to the Committee

The City Club of Portland has charged your Committee with addressing the major issues which affect the control of air pollution in Portland. The tasks involved were basically three:

Task 1: We were instructed to familiarize ourselves with current federal, state and local air pollution regulations, pollution sources and types, and pollution control and measurement technology, with particular regard to specific pollutants and their sources, health effects, regulatory responsibilities and the function of groups with interests in the air pollution area.

Task 2: We were instructed to determine if there presently exists a comprehensive, workable, and coherent air pollution control policy as a guide for decision making in the Portland area. If policies do exist, who administers them? What is the impact of competing interests on the effectiveness of the policies and their administration? Are multiple agencies attempting to interpret and administer the same policies or regulations with inconsistent results? Are the policies comprehensive enough? Are the policies flexible enough to take into account new unpredicted factors? Do the policies take into account the possibility of alternative pollution control strategies? Do they use effective criteria for selecting control strategies?

Task 3: We were instructed to make recommendations for new policies and policy implementation, taking into account: social factors such as health, livability and freedom of choice; environmental issues such as potential physical degradation to structural forms or degradation of natural systems; economic factors — the cost to industry or individuals; and transportation.

In addition, eight specific questions were posed in the charge:

1. How good are our control mechanisms, both political and technological?
2. What alternative control mechanisms are available? What are the social, health, environmental and economic consequences of the alternative mechanisms?
3. Is there parity between industrial and other source controls?
4. What are the most cost-effective investments to be made?
5. Are we to limit economic development, pending some way to achieve cleaner air?
6. What are the consequences of relaxing controls, should the federal government decide to do so?
7. To what extent should the individual's right to pollute be curtailed?
8. Is it equitable that the individual should be regulated less strenuously than has been the business community?
B. Method of Study

Your Committee began its work with the process of educating itself on the issues listed in Task 1 of the charge. To familiarize itself with the current status of Portland's air quality and the regulations which govern it, the Committee invited and interviewed witnesses from the U.S. Environmental Protection Agency (EPA), the Oregon Department of Environmental Quality (DEQ), the City of Portland, the Port of Portland, the Associated Oregon Industries (AOI), the Oregon Environmental Council, the Portland Air Quality Advisory Committee (PAQAC), the Metropolitan Service District (Metro), the Multnomah County Board of Health, the Environmental Quality Commission (EQC), and various private consultants who had assisted these agencies in their work. (See Appendix A for full list of persons interviewed.)

Written material, often voluminous, was supplied to us by witnesses from their agencies and on request from DEQ, Metro and the City of Portland. (See Appendix B, Bibliography.) The numbers which appear in parenthesis throughout the report refer to sources listed in Appendix A and B. We were fortunate to have the services of a research intern, Mr. Bruce Dumdei, to assist us by abstracting this material and to guide us through some of its technical intricacies. (Mr. Dumdei is a doctoral candidate in environmental science, specializing in air quality.)

C. Report Organization

Air pollution, by its very nature, is a highly technical and complex subject, as is reflected by the lengthy discussion which follows. Your Committee has endeavored to present this information in a methodical and straightforward manner. The Summary (Section I, D) provides a synopsis of the air pollution issue, existing laws and regulatory agencies, and current control programs.

The body of the report (Sections II-IV) begins with a general description of air pollution and its potential harmful effects, then describes the state and federal legislation enacted to regulate pollutants. The report then turns specifically to Portland, describing the local airshed's relationship to federal air quality standards, detailing the sources of Portland's pollution, and outlining the many regulations and programs currently existing to control Portland's air quality.

Section V, Discussion, Conclusions and Recommendations, presents a discussion of the major issues raised in the charge to the Committee, and the issues which your Committee believes will be critical for Portland's air quality in the next few years. Again in this section, we begin with broad, general points and proceed to more specific concerns. Section V is organized to consider the questions raised in the charge within the context of the major issues in air quality control that emerged during the course of the study. Since there are several overlapping questions in the charge, the questions have served to underlie the discussion of issues rather than to provide an organizational framework.

The technical difficulty of the subject matter, along with the general lack of prior familiarity with the issues by Committee members, required your Committee to spend many months just learning the basics of air quality management. To help readers with a similar lack of background, a glossary of air quality terms is included as Appendix C.
D. Findings: Summary of Sections II—IV

All of the gases and particles in the air commonly referred to as "pollution" exist naturally in the atmosphere. However, man-made pollution from industrialization and population growth has increased the concentrations of these substances, overcoming the natural balance in the atmosphere.

There are seven major types of air pollution, referred to in the Clean Air Act as "criteria pollutants:" carbon monoxide (CO); ozone; volatile organic compounds (VOC); oxides of nitrogen (NOx); total suspended particles (TSP); sulfur dioxide (SO2); and lead.

The U.S. Environmental Protection Agency (EPA) has set standards for the maximum allowable concentration of these pollutants. The primary standard represents the concentration level intended to prevent harm to the public health. A secondary standard, sometimes stricter than the primary standard, represents the level of pollution intended to prevent harm to the public welfare (e.g., irritation, soiling, reduced visibility). In determining these standard levels, the EPA attempted to include a margin of safety beyond the level believed to cause harmful effects. However, due to the difficulty of determining the effects of long term, low level exposure on large segments of population, there is considerable uncertainty in the scientific community as to how large a margin of safety is desirable, and how much actually exists in the current standards.

The adverse health effects of air pollution are varied, depending upon the specific pollutant involved. In the cases of some past severe air pollution catastrophes, increased mortality was reported. However, recent studies have found little evidence of a relationship between current air pollution levels and mortality. Increased levels of acute respiratory illness have been reported in communities with high concentrations of ozone, nitrogen dioxide, sulfur dioxide and particulates. Air pollution levels also may have adverse effects on some asthma sufferers and certain persons with coronary disease. The evidence to date does not establish whether or not air pollution leads to lung cancer.

Although some regulations to control pollutant emissions have existed in this country since 1881, most of the current laws and regulations stem from the federal Clean Air Act Amendments of 1970. The act had three major features: 1) it established national primary and secondary standards for ambient concentrations of the pollutants described above; 2) it set national emissions standards for new motor vehicles and for industrial sources considered to be heavy polluters; 3) it left to the states the rights and responsibilities to develop state implementation plans to reach compliance with the national standards.

The 1970 legislation called for all parts of the country to comply with primary ambient standards by 1975. Subsequent amendments pushed back the deadline for attainment with the standards to 1982, with an extension to 1987 for some pollutants in areas of the country which met specific requirements for reasonable progress toward attainment. Refinements in the emission limits for industries and motor vehicles were also made.

In order to encourage compliance with provisions of the Clean Air Act and its amendments, the EPA is allowed to withhold federal grants for sewers and highways.
In 1981, the Portland/Vancouver Air Quality Maintenance Area (Portland AQMA) was in non-attainment (i.e., not in compliance) with the primary standards for CO and ozone, and with the secondary standard for TSP. An area is deemed to be in non attainment if the ambient concentration of a particular pollutant exceeds the standard level twice in one year (or, in the case of ozone, three times in three years). Therefore, being in non attainment does not represent the degree to which the standard is exceeded, but rather the fact that occasional peak levels are above the standard.

In 1981, there were 24 days in the Portland AQMA which violated the primary standard for CO. There has been a steady downward trend in the number of CO violations over the past ten years. There were five violations of the primary ozone standard in the Portland AQMA in 1981, all occurring during a severe August heat wave. There has not been a clear trend in the number of yearly ozone violations. There were five violations of the secondary standard for TSP in the Portland AQMA in 1981, but no violations of the primary standard. There has been no clear trend in the number of these violations over the past decade.

Pollution levels and the number of violations are strongly influenced by weather conditions. Portland is located in a valley surrounded by hills and mountains, and stagnant wind conditions and temperature inversions are not uncommon. Pollutants are trapped near the ground and concentrations build when these stagnant conditions occur. Most violations of the standard for CO and TSP occur during the fall and winter months when these weather conditions are most common. Because heat and sunlight are major factors in the creation of ozone pollution, most violations of ozone standards occur during the warm summer months.

Two main methods are used to track air quality in the Portland area. Ambient concentrations of pollution are measured at 25 sites throughout the area to determine exceedances of the ambient standards. Specific sources of pollution are identified by annual emissions inventories. Estimates of emissions from stationary industrial sources, motor vehicles and area sources (e.g. wood stoves, field burning) are made, using actual measurements when possible and computer models which consider factors like population and employment patterns.

Motor vehicle exhaust is the single largest contributor to air pollution in the Portland area. Motor vehicles contribute 90% of total CO emissions and about half of the total emissions of VOC, which contribute to creation of ozone pollution. As more older vehicles have been replaced by new cars subject to the emission standards specified in the Clean Air Act, the amount of emissions from motor vehicle exhaust has declined dramatically. Motor vehicle exhaust now accounts for only 5% of TSP emissions. However, road dust, which is largely stirred up by vehicle traffic, accounts for 59% of TSP.

Industry's current contribution to pollution in the Portland area is, in most cases, considerably less than motor vehicles, and in some cases, even less than such sources as wood stoves. In 1980, industry accounted for only 8% of TSP emissions, 3% of CO emissions, and 22% of VOC emissions. Industrial emissions of TSP dropped 71% between 1970 and 1980.

While emissions from motor vehicles and industry in the Portland area generally have been declining in recent years, emissions from vegetative burning (wood stoves, fireplaces, backyard burning, field and slash burning) have been on the increase. Despite the sharp drop in industrial emis-
sions, overall TSP emission levels are expected to increase 19% between 1970 and 1987. The most significant influence on this trend has been the growth of wood stove use for residential heating. The amount of wood burned for residential heating is expected to have grown from 220,000 cords per year to 480,000 cords per year in the 1970-1987 period. During that period, the TSP emissions from residential wood heating are projected to have increased 144%.

The EPA is the federal agency charged with carrying out the requirements of the Clean Air Act. Although the Act assigns the primary responsibility to the states for implementation and enforcement, in practice, the EPA exerts considerable power through its standard setting and other national guidelines. Though operating by Congressional mandate, the agency has considerable flexibility in making administrative rules and allocating staffing and federal grant money.

Pollution control policies at the state level are established by the Environmental Quality Commission (EQC), a five member board appointed by the Governor. The state Department of Environmental Quality (DEQ) is the administrative agency charged with carrying out the policies developed by the EQC. Metro, the Portland area's regional government body, has no direct control over air quality matters. However, it has statutory responsibility for area transportation planning which has a considerable indirect impact on pollution from motor vehicles.

Metro and DEQ established the Portland Air Quality Advisory Committee, a broadly representative volunteer body, to provide advice on development of state implementation plans for the three pollutants for which the Portland area is in non attainment. The committee's official reason for existence ended when the plans were completed and adopted by the EQC in 1982.

The Washington Department of Ecology and the Southwest Washington Air Pollution Control Authority are largely responsible for air quality policies and programs in the Clark County portion of the Portland AQMA. Many other cities, counties and state agencies have an indirect impact on air pollution through transportation, land use, economic development and environmental policies.

Among the many regulations and programs adopted to reduce emissions of pollutants, clearly the most effective have been the Clean Air Act's emission standards for new motor vehicles. Auto emission controls have been responsible for most of the reductions of total CO, VOC and lead. The 1970 Clean Air Act Amendments specified that most emissions from auto exhaust be reduced by 90% by 1975. Final implementation of the most strict emission standards has been delayed repeatedly, but in most cases the 90% reduction has been achieved beginning with 1983 model vehicles. Therefore, continuing declines in overall levels of CO and VOC should occur as newer cars replace older ones. This is a major factor in DEQ's projection that the Portland area will achieve attainment with ambient CO and ozone standards by the 1987 deadline.

The Clean Air Act requires that industries in areas which comply with ambient standards utilize the "best available control technology" to reduce emissions. This is defined as the most effective methods and equipment available, considering reasonable cost and difficulty. In areas in non attainment, however, a stricter requirement, the "lowest achievable emission rate," applies. This requires use of the best control measures without regard to cost or difficulty.
In Oregon, all major industrial emission sources are required to obtain an Air Contaminant Discharge Permit and to develop a schedule for compliance with industrial emission standards. An existing plant cannot alter its operations in any way that increases emissions without first receiving a modified permit from DEQ. Additionally, major new sources wanting to locate in a non-attainment area are required to do an extensive analysis of the resulting emissions, of emissions from neighboring sources and of the impact of new emissions on the airshed, and prove that the benefits of the new source significantly outweigh the environmental and social costs that result.

In non-attainment areas, room must be created in the airshed for major new sources either with an "emission offset," or a "growth cushion." A proposed new source can create an offset by purchasing control equipment, or otherwise arranging emission reductions, for existing sources in the region. These reductions offset the emissions to be created by the new source. A growth cushion is created when programs to reduce ambient pollution levels are designed not only to reach the standard level, but to go beyond the standard. The incremental difference between this reduced emission level and the allowable standard can then be allocated to new sources on a first come, first served basis.

Perhaps the most visible emission control program in the Portland area is the DEQ's mandatory biennial vehicle inspection and maintenance program, begun in 1975. An EPA study indicated that the inspection program achieved emission reductions of 34% for CO and 24% for VOC. This program is another important factor in the projected decline of emissions from motor vehicles.

Many transportation-related programs have achieved important benefits for air quality in the Portland area, even though the programs are planned and operated for other purposes (e.g., relieving congestion, improving traffic capacity) than air quality alone. The Portland Downtown Plan, adopted in 1972, resulted in a limit on the number of parking spaces in downtown Portland. Development of the transit mall, Fareless Square, purchase of additional buses and construction of light rail lines have helped increase transit ridership 230% in the area since 1969. Reserved parking meters, high occupancy lanes and car pool information programs have brought the number of people who commute in car pools of two or more to about 18% of the tri-county population. All of these programs have helped to keep the number of cars entering and leaving the downtown area fairly stable, despite dramatic growth in downtown employment. As a result, motor vehicle emissions have been lower than they otherwise would have been.

In the years since enactment of the 1970 Clean Air Act Amendments, major progress has been made in reducing pollutants in the Portland airshed. However, the area continues to have a small number of violations of ambient air quality standards. There are air quality issues which continue to be of major concern to the community. A full discussion of the issues accompanies the conclusions and recommendations in Section V.

II. BACKGROUND

A. What is Air Pollution?

Any airborne substance potentially capable of harming human health or welfare is an air pollutant. All of the gases and particles commonly referred to as "pollution" occur in the atmosphere naturally. Natural
serves include hydrocarbons from forested areas, stratospheric ozone, wind-carried particulates, particles and gases from volcanic activity and forest fires. However, man-made pollution from industrialization and population concentration has increased the amounts of these substances in the atmosphere and has overcome nature's own purification systems of wind, rain, and plant life. Therefore, it is not the simple presence of certain chemicals in the air but rather their concentration which causes them to be referred to as "pollutants."

There are seven major types of ambient air pollution.

1. Carbon monoxide (CO). This colorless, odorless toxic gas is the most widely distributed and commonly occurring pollutant in the nation. There is more carbon monoxide emitted into the atmosphere than all other major air pollutants combined. (34) Most of it comes from incomplete or ineffective combustion of fuels containing carbon, primarily from automobile engines.

2. Photochemical oxidants, primarily ozone. Photochemical oxidants are oxygen-bearing compounds created by photochemical reaction. Ozone is a colorless gas and is the oxidant of major concern. It is not emitted directly from industrial or vehicle sources but is created when ultra-violet solar radiation reacts with nitrogen dioxide in the presence of atmospheric hydrocarbons.

3. Volatile Organic Compounds (VOC). There are a vast number of hydrogen and carbon-containing compounds called hydrocarbons. Hydrocarbons involved in the creation of air pollution are mostly Volatile Organic Compounds (VOC) and are defined as those compounds that evaporate readily at room temperatures. Hydrocarbons of the "VOC" type are created by incomplete combustion of gasoline and by the escape of vapors from gasoline and other petroleum sources. The major impact of hydrocarbons is their role in the production of photochemical oxidants such as ozone.

4. Oxides of nitrogen (NO). At high combustion temperatures such as occur in vehicle engines, the combination of the naturally occurring nitrogen and oxygen in the atmosphere creates oxides of nitrogen. The two most important are nitric oxide and nitrogen dioxide. The latter is a brownish, poisonous gas. Being a colored gas, it reduces visibility. Both are important ingredients in the photochemical reaction which creates ozone.

5. Total suspended particulates (TSP). Particulates are any solid or liquid materials dispersed in the air that are small enough (less than 500 microns) to remain airborne more than a few seconds. Some particulates may stay airborne for days or months. They may be divided into those which are respirable (size less than 2 microns) and those larger ones which are nonrespirable. Respirable particles are of sufficiently small size to reach the lower respiratory parts of the human lung. Particulates are ubiquitous, coming from multiple sources. In terms of total mass, the major source is soil in the form of road dust. (31)

6. Oxides of sulfur (SO₂, SO₃). Sulfur is a nonmetallic element found in coal and petroleum products. When these materials are burned, the sulfur is converted to sulfur dioxide and sulfur trioxide, forming gases which are combined with water to form sulfuric acid. Nationwide,
two-thirds of all sulfur oxide emissions come from coal- or oil-fired electricity generating plants. These are associated with the phenomenon known as "acid rain."

7. Lead. Lead is an abundant element of the earth's crust, common in food and water. Atmospheric lead is primarily in the form of particles emitted from automobiles using leaded gas.

B. Health Effects of Air Pollution

1. Determination of Federal Standards. The EPA was charged with establishing national air quality standards under the Clean Air Act (see detailed description in Section II, C). Two types of standards were developed: ambient air quality standards to regulate the overall concentration of pollutants in the air; and emission standards governing the quantities of pollutant emissions discharged by a particular source. In setting the primary (health-related) federal standards for ambient concentrations of air pollution, it was EPA's intent to protect the most sensitive groups in the population and to incorporate a margin of safety to protect against hazards still unidentified. Decisions on setting allowable standards for a given pollutant were based on air quality criteria documents prepared by the EPA that reviewed the available scientific literature relevant to the possible health hazard of each pollutant. Each standard must be re-evaluated periodically and must be revised if new scientific information so dictates. The Committee on Medical and Biological Effects of Environmental Pollutants, National Academy of Sciences-National Research Council, has overseen the preparation of these comprehensive reports for the EPA. There are four major sources of information on health effects:(81)

   a) Historic events involving unusually high episodes of pollution have occurred in this century which have clearly established the adverse health effect of serious air pollution. No such serious episodes have occurred in the past two decades.

   b) Considerable experimental work with animals has been carried out with varying results. Interpretation is made more difficult due to the problem of extrapolating animal data to humans.

   c) Controlled exposure of human volunteers, either normal or with specific disease, has been carried out to a limited degree. However, because of ethical and practical considerations, human experiments are limited to short term reversible effects and to adults without advanced stages of disease.

   d) Epidemiological studies of large population groups have been carried out by multiple researchers, again, with conflicting results and interpretation. The major problem in epidemiological studies is the influence of many variables other than the pollutant being studied, specifically, smoking, occupation, climate, infectious diseases, genetic, cultural and socioeconomic influences.

Because of the cited limitations of epidemiological and experimental studies, it is impossible for even qualified professionals to determine how large a margin of safety exists in current standards. Hence, major differences of opinion exist within the scientific community as to the appropriate margin of safety, and whether current standards provide
such a margin. Estimates for the margin of safety range from 2-10 times the level of an average city’s average ambient concentrations of pollutants. The lower concentrations represent levels which may be reached occasionally in the ambient atmosphere. Although it would be desirable to set standards at levels low enough to avoid adverse effects in all instances, in practice it is not feasible to determine that level for all segments of the population. Hence, current standards do not guarantee that unusually sensitive persons will be protected against all adverse health effects, especially if the effects are worsened by the presence of other pollutants, other health conditions or risk factors (such as smoking), or unfavorable meteorologic conditions.

2. Effects of Specific Pollutants. There is ample evidence that all of the pollutants for which air quality standards exist produce toxic effects in animals (and presumably humans) exposed to sufficiently high concentrations. As stated above, the low-level threshold for significant toxic effects is very difficult to determine. Subtle changes which are statistically quantifiable may have no adverse effect on human health, disease, or longevity.

a) Carbon monoxide. The primary adverse effect of carbon monoxide is to reduce the oxygen carrying capacity of the blood. Certain people with cardiovascular disease may show adverse symptoms when the level of hemoglobin bound with carbon monoxide reaches 2 1/2 to 3%. Exposure at the current standard will cause a blood concentration of 1 1/2%. As a comparison, smokers routinely carry concentrations of 4 to 7%.

b) Ozone. There is eye and respiratory irritation at levels near the current standard. At higher concentrations, ozone may induce asthmatic attacks or increase susceptibility to respiratory infections. The panel on photochemical oxidants and ozone of the Committee on Medical and Biological Effects of Environmental Pollutants of the National Academy of Sciences concluded: 1) adverse health effects from short-term exposure to photochemical oxidants and ozones at the current standard level have not been observed in man, and; 2) data from human and animal studies suggest that adverse health effects might be expected at concentrations near the standard, especially under conditions of long-term exposure or in the presence of co-pollutants.

c) Nitrogen dioxide. The toxic effects of nitrogen dioxide are similar to those of ozone but require higher exposure concentrations than ozone. Most studies of short term exposure show no effects at levels attainable in ambient air. Long-term exposure to levels of 1-3 times the standard has been correlated with increased incidence of acute viral respiratory illness in children.

d) Sulfur Oxide/particulate complex. These two pollutants are usually discussed together regarding their health effects because increased concentrations of both pollutants are usually found together and, hence, the epidemiologic studies are of populations who have been exposed to the pollutant mixture rather than the individual pollutants in isolation. At levels slightly exceeding the standards, visibility is limited and/or human eye or respiratory irritation occurs. Levels of approximately twice the standard may cause respiratory symptoms and subtle measurable changes
in lung function. Patients with pre-existing pulmonary disease will show increased symptoms at levels of 3 to 6 times the standard. Studies of sulfur dioxide alone have generally not shown detectable adverse effects except at concentrations substantially higher than those attained in polluted ambient air. Therefore, it has been assumed that the particulates are the most important substance in this complex relating to adverse health effects.\(^{(51)}\)

e) Volatile Organic Compounds. These substances, in themselves, do not represent a health hazard but are important as precursors of ozone and other oxidants as mentioned above.

3. **Adverse Health Effects of Air Pollution.**\(^{(51)}\) The adverse health effects of air pollution are discussed by categories of effects:

a) **Air pollution-associated mortality.** While increased mortality was observed with past major air pollution catastrophes, recent studies find little evidence for a relationship between current air pollution levels and mortality. Studies of oxidant air pollution and mortality have not demonstrated a relationship between deaths and direct measurements of peak or daily oxidant concentrations among residents of Los Angeles County where some of the highest ambient ozone concentrations are reported.

b) **Chronic respiratory disease aggravation.** An increased incidence of acute respiratory illness has been reported in communities with high ambient concentrations of ozone, nitrogen dioxide, and sulfur oxide/particulate concentrations. However, the specific pollutant concentration at which this increased risk of acute illness occurs has not been established.

c) **Effect on lung function.** At concentrations which are attainable in ambient air (above standard), subtle measurements of decline in lung function can be measured. This is usually in association with ozone and the sulfur oxide/particulate complex. Whether these changes are medically significant is unknown.

d) **Exacerbation of asthma.** Increased rates of asthma attacks have been noted when episodes of sulfur oxide/particulate and ozone air pollution occurred. However, air temperature variations correlate even more strongly with attack rates and make the separation of temperature from pollutant effect more difficult. Some of the studies indicate that increased air pollution concentrations are one of many factors that can precipitate attacks in some fraction of asthmatic patients.

e) **Lung cancer.** The evidence thus far does not establish whether or not air pollution leads to lung cancer.

f) **Cardiovascular disease.** The main pollutant having adverse effects on persons with some forms of pre-existing coronary heart disease and peripheral atherosclerosis is carbon monoxide in high ambient concentrations.

g) **Neurologic and behavioral effects.** Irritative effects, odor annoyance, and visibility interference may have psychological or
behavioral effects on people. These have not been scientifically quantified. High levels of carbon monoxide pollution, however, can alter human neuro-behavioral performance.

C. Legislation Dealing with Air Pollution Control

During the first one hundred years of the United States' existence, air pollution problems were settled by litigation among the parties rather than by legislation (as a common law nuisance – private nuisance, public nuisance, or trespass).

After this period, the abatement of air pollution under the nuisance doctrine gradually gave way to resolution of this problem by governmental agencies created by specific air pollution control legislation. The first legislation to control smoke emissions was enacted in 1881. (Oregon was the first state to enact state-wide air quality legislation, in 1952.)

The current Federal Clean Air Act is a composite of a number of legislative efforts spanning the past two decades. The Air Pollution Control Act of 1955 was the federal government's first involvement with the problem of air pollution. Its role was very limited, being confined to conducting research and making recommendations at the request of the states. The primary responsibility for air pollution control was left with the states.

The first Clean Air Act, passed in 1963, was inspired by four events:

(1) The publication of Rachel Carson's "Silent Spring";
(2) The London smog disaster of 1952 which resulted in 4000 excess deaths in a four-day period;
(3) An air pollution episode in Birmingham, Alabama;
(4) The Second National Conference on Air Pollution held by the Department of Health, Education and Welfare in Washington, D.C.

This law expanded the national research and technical assistance programs available to the states and provided for the development of air quality criteria. These criteria were advisory guidelines on the nature and effects of various pollutants.

Congress's first attempt at a comprehensive regulatory program of air pollution control was the Air Quality Act of 1967. This act required the states to adopt "ambient air standards" defining the maximum pollution concentrations allowable. These standards, while set by each state, were to be consistent with air quality criteria provided by the federal government. The states were also required to develop "implementation plans" detailing how the states were going to meet their standards. Emission standards for a single source were not required by federal law. In addition, there was no deadline for compliance with the standards.

In 1970 Congress undertook a major overhaul of the preceding air quality legislation. The result was the Clean Air Act Amendments of 1970 which formed the basic blueprint for the current air pollution control efforts and established the legislative base for the EPA. This act contained a three-part plan.

First, it established national ambient air quality standards. Two types of ambient standards were to be uniformly applied across the country. The "primary standards," defined as the maximum amount of pollution that could be allowed without endangering public health, were to be met by 1975.
More stringent "secondary standards" specifying the amount of pollution that could be allowed without endangering public welfare were to be attained within a "reasonable time." Endangering public welfare included damage to buildings, plants, and crops, reduction of visibility and irritative effects to humans.

Second, the 1970 act set national emission standards for both motor vehicles and new industrial sources considered heavy polluters.

Finally, the act reiterated the principle that the states would be primarily responsible for the attainment and enforcement of the federal standards and, in accordance with this act, would develop state implementation plans documenting how the state would comply with the act requirement.

Eight areas were to be addressed in the state implementation plans: 1) attainment of standards by the prescribed deadlines; 2) emission limitations and other controls including but not limited to land use and transportation controls; 3) monitoring of air quality within the state; 4) preconstruction review of new sources to be located in areas that have attained standards; 5) inspection and testing of motor vehicles; 6) proof of adequate intergovernmental cooperation in the development of the plan; 7) assurance that the state will have adequate personnel, funding and authority to carry out the plan; and 8) provisions allowing for periodic revision of the plan.

Several areas remained unresolved after passage of the 1970 act. (34)

(1) Despite the adoption of the state implementation plans by the majority of states, the nation's major cities still violated the prescribed ambient air quality standards.

(2) There was no provision for industrial growth in areas that currently violated standards. In order not to ban industrial growth in areas of violation, a compromise known as the "Offset Policy" was established in 1976. This policy allowed a new industry to locate in an area which did not meet federal standards, provided that it could arrange or finance sufficient reductions of existing emissions in its area to offset its own anticipated emissions. More than a one-for-one tradeoff was required, such that, after the new source began operating, there had to be a net benefit to the air quality of the area. If the source provided more emission reductions than necessary, the excess of offsets could be saved or "banked" for later expansion.

(3) The act made no provision for areas that were cleaner than the air quality standards. The issue of whether clean areas could be allowed to deteriorate to the levels specified in national standards was answered in a 1972 court action which stated that the act's stated purpose was "to protect and enhance the quality of the nation's air resources." Subsequently, the EPA in 1975 formulated a program for the prevention of significant deterioration of ambient quality.

In 1977, while leaving the basic structure of the previous Clean Air Act intact, Congress passed certain far-reaching amendments. The deadline for compliance with the air quality standards was extended so that "primary standards" were to be met by December, 1982. However, because of anticipated difficulties in meeting ozone and carbon monoxide (transportation related) pollution standards, an additional extension of five years was made available for these two only. In order to be allowed this extension, the
states were required to demonstrate that it was impossible to meet the earlier deadline despite the implementation of "reasonably available" control measures. Such measures included vehicle inspection and maintenance programs, vapor emission control programs, transit improvement programs, parking controls, and transit and carpool lanes. The "secondary standards" continued to carry the "reasonable time" deadline.

In addition, the 1977 amendments more clearly established guidelines for emission limitations from stationary sources, sometimes called "point sources." These are primarily industries. Existing industries were to be subject to emission standards corresponding to the application of "reasonably available control technology." The states were allowed to consider technological and economic feasibility in setting the standards. New industries, which emit major quantities of pollutants, were subject to one of two standards depending on whether their new location was in an area of attainment or non attainment. In areas not violating federal standards (in attainment), major new sources had to apply the "best available control technology." This standard also allowed weighing of technologic and economic factors but implied a more stringent limitation than that imposed on existing industry by the "reasonably available control technology." In non-attainment areas, major new sources, in addition to requiring "offsets," were subject to the "lowest achievable emission rate." This is the lowest emission rate actually achievable, in practice, without consideration of economic impact.

The 1977 act also created a framework in which the states could provide for the "prevention of significant deterioration" of clean areas. This program provided that the nation's clean air areas be divided into three classifications with varying increments of allowable pollution. Class I areas were those in, or adjacent to, a National Park or Wilderness area and had the lowest levels of allowable additional pollution. In Oregon, Crater Lake National Park and eleven wilderness areas are so designated. In Class II areas, some additional pollution is allowable. The rare Class III designation allows the largest additional amount of pollution, as long as it is not in excess of ambient standards. (There are no class III areas in Oregon.) Except for the mandatory Class I areas, the state is allowed to redesignate area classification if local government and the majority of residents in a designated area pass legislation approving the redesignation.

The method by which incremental growth of industry, and related potential pollution, is to be allocated is left to the states. Oregon operates a permit-issuing procedure under the direction of DEQ. The 1977 act also provides that states develop their own methods of offset policy to allow growth in non-attainment areas. Finally, the states were required to revise their implementation plans in accordance with the 1977 amendments. The deadlines for submitting the new implementation plans depended upon the pollutant. Oregon has completed its revised plans for the Portland area for ozone, carbon monoxide, and TSP.

In order to encourage compliance with provisions of the Clean Air Act and its amendments, the EPA administrator is allowed to withhold federal sewage grant funds and is required to withhold federal highway funds that do not relate to safety or mass transit.

The Federal Clean Air Act was due for reauthorization by Congress in 1981. Because of major controversies over various provisions of the Act, this reauthorization has not yet occurred.
Oregon Revised Statutes 468.005 - .035 deal with the establishment of the Environmental Quality Commission and DEQ to comply with federal air quality legislation.

D. Portland's Air Quality Status

In an attempt to provide clear and consistent advice to the general public through the news media, the EPA has developed a Pollution Standards Index to be used in reporting on air quality. The relation of the Pollution Standards Index levels to pollution concentrations and the recommended protective actions is shown in Table 1. The standards and the Pollution Standards Index are intended to protect the most sensitive groups in the population.

1. Oregon and Federal Standards. Table 2 gives the federal primary and secondary standards, the Oregon standards, and the averaging time of measurement for the seven classes of pollutants. As stated previously, the primary standards are designed to protect the public health with a built-in margin of safety. Secondary standards may be more strict where it has been determined that adverse effects to public welfare such as visibility reduction, material and building damage, and irritation to humans occur.

Federal primary and secondary standards are identical for all pollutants except TSP. Oregon standards have been set at federal secondary (welfare) standards. The Oregon ozone standard was relaxed to match the federal standard in January, 1982. It should be noted that there is no standard established yet for fine particulates separate from the total suspended particulate standard. DEQ has established a fine particle monitoring network in order to compile data relating to current levels and to evaluate trends.

2. Portland/Vancouver Air Quality Maintenance Area. In 1981, the Portland/Vancouver Air Quality Maintenance Area (subsequently referred to as Portland AQMA) was in non attainment with federal primary standards for carbon monoxide and ozone. The Portland AQMA is in violation of the secondary standard for TSP and in attainment in the other categories. There are some 25 continuous air monitoring sites and 9 meteorological monitoring sites within the Portland/Vancouver air surveillance network. Most of these are maintained by the DEQ.

An exceedance is counted if any sampling site records a value above the standard for a particular pollutant at any time during the year. Two exceedances for CO and TSP, and a 3-year average of one per year for ozone result in non attainment. Therefore, violations do not represent the actual degree to which the standard is exceeded, nor do they imply a widespread violation within the area since monitored values may vary considerably among different sites on the same day.

a) Carbon monoxide. In 1981 there were 24 days in the Portland AQMA which exceeded the eight-hour standard of 10 milligrams per cubic meter. There were no violations of the one-hour standard. The majority of these violations (16) occurred at the downtown Portland monitoring site. The maximum violation value there was 14.3 milligrams per cubic meter. As seen in Table 3, there has been a clear and continuing downward trend in the number of violation days for carbon monoxide. The single most important
factor in these improved levels is the reduction of automobile emissions as a result of the Federal Emissions Control Program for new automobiles.

b) **Ozone.** There were five violations of the federal standard in the Portland AQMA in 1981, all occurring in the Canby area, downwind from Portland, and all occurring during the severe and abnormal heat wave in August, 1981.\(^{31}\)

c) **Total suspended particles (TSP).** In the Portland AQMA in 1981, there were five violations of the Oregon standard but no violation of the primary federal standard for TSP.\(^{31}\) The downtown Portland monitoring station had the most violations with two. Sixteen violations occurred at this site in 1980, mostly as a direct result of the Mt. St. Helens volcanic activity. Disregarding the volcano-induced violations, there has been no clear five-year trend in the Portland AQMA regarding increasing or decreasing levels of particulates.

d) **Nitrogen dioxide.** No violation of the nitrogen dioxide standard has ever been recorded in Oregon.\(^{31}\) The annual arithmetic mean has been stable over the past decade (range 40-66) and below the standard of 100 micrograms per cubic meter.

e) **Sulfur dioxide.** Only one violation for the sulfur dioxide standard has ever been recorded in Oregon and none were recorded in 1981.\(^{31}\) The 1981 downtown Portland annual arithmetic mean value of 20.9 was well below the standard of 60 micrograms per cubic meter. There appears to have been a gradual decline in sulfur dioxide values in the past decade.

f) **Lead.** Atmospheric lead levels continue to decrease, with all but three monitoring sites recording all time low values in 1981. This trend is due to the reduction in leaded gasoline usage. Only one violation of the lead standard in Oregon has been recorded since 1976.

3. **Meteorologic Factors.** The level of pollution at any given time depends on the rates of emission of pollutants and on the rate of their dispersal in the atmosphere. The latter is largely determined by weather conditions. Wind, rain, and the normal air movement between atmospheric layers all serve to disperse the pollutants. Winter storms with relatively high wind speeds from a southwesterly direction are the most favorable in terms of dispersing air pollution.

Because Portland is located in a valley with surrounding hills and mountains, stagnant meteorologic conditions consisting of slow wind speeds and temperature stratifications create inversions during certain times of the year. During these inversions, which occur especially during fall and winter, warmer air moves above cool surface air and prevents upward movement of the surface air. This traps air pollutants and they accumulate.

Stagnant air conditions and atmospheric temperature inversions are major factors in violations. The National Weather Service attempts to predict poor atmospheric conditions and issues air stagnation advisories. Portland had an average of nine air stagnation advisory days per
year in the past decade. (31) It should be noted that not all occurrences of stagnant conditions lead to elevated air pollution levels.

III. SOURCES OF POLLUTION IN THE PORTLAND AIR QUALITY MAINTENANCE AREA

A. Portland Air Quality Maintenance Area

The 861 square mile Portland-Vancouver Interstate Air Quality Maintenance Area was established in accordance with EPA regulations adopted on March 18, 1974. In 1980, the four-county Portland-Vancouver metropolitan area had 1,245,020 inhabitants, 1,030,193 motor vehicles, and 114,800 employees in industrial manufacturing (an indicator of industrial capacity). The 695 square mile Oregon portion of the Portland AQMA, upon which much of this report focuses, includes the Portland metropolitan area and most of Washington, Clackamas, and Multnomah counties.

During the period from 1970 to 1987, which begins before implementation of the Clean Air Act and continues to the federal deadline for compliance with air quality standards, the four-county Portland-Vancouver metropolitan area is expected to experience a population increase from 1,007,130 to 1,420,000, an increase in motor vehicles from 715,925 to 1,175,450, and an increase in industrial manufacturing employees from 85,700 to 149,800 (30, 41, 43).

B. Emissions Inventory and Site Monitoring

Two main methods are used by the DEQ to track actual air quality in Portland and to identify the sources of pollution: emission inventory and site monitoring. The DEQ estimates the total quantity of pollutants introduced into the air of the Portland AQMA (Oregon portion) and the quantities introduced from individual sources by conducting annual emission inventories of all known sources for each of the major pollutants. Estimates of emissions from stationary industrial sources, area sources like commercial and residential heating and open burning, and mobile sources (motor vehicles) are determined by considering stack test information, when available, or EPA national averages for the processes and equipment used and the number of contributors for each source. For motor vehicle emissions a computer modeling technique is used to determine vehicle miles traveled and total emissions within the Portland area. Computations are based on assumptions about vehicle emission factors and upon assumptions about patterns of population, employment, and land use.

The emission inventory process for indirectly estimating the quantities of pollutants introduced into the entire Portland AQMA airshed should not be confused with the site monitoring process for directly measuring the concentrations of pollutants in the air at multiple sampling sites. Emission inventories facilitate the regulatory process by identifying the contributions of individual sources or groups of sources to air pollution, but do not actually measure air quality. Site monitoring determines how well actual air quality compares to federal standards at specific sites and times but does not usually identify the sources of the pollutant measured.

The graphs in Tables 4, 5, 6 and 7, compiled by the Committee from data collected by DEQ, show the daily ambient air concentrations for TSP, CO and ozone in 1981 at key measuring stations in the Portland area. These stations had the highest number of violations for the given pollutant. Horizontal lines are drawn at the current ambient standard levels. Any points above that line represent a day on which a standard exceedance occurred.
Note that the greatest fluctuations and the highest peaks for CO and TSP occur during the late fall and winter, when air stagnation is most common, and when backyard burning and wood stove use are heaviest. In the case of ozone, this pattern occurs in summer months when long hours of sunlight and high temperatures spur creation of this pollutant.

Sources of pollution in the Portland area vary depending upon the particular pollutant being discussed. The graphs in Table 8 show the percentage of emissions from various sources for six of the seven criteria pollutants identified in the Clean Air Act (the seventh, ozone, is not included because it forms indirectly in the atmosphere). Table 9 shows total emissions for major pollutants in 1970, 1980, and 1987 (projected) (40, 41, 49).

Some of the major sources of emissions in the Portland area are discussed below:

1. Motor Vehicles. Motor vehicles are the single largest contributor to air pollution in the Portland area. This holds true for CO, VOC, NOx, lead (resulting from exhaust), and TSP (resulting from road dust). The impact of motor vehicles on concentrations of CO and ozone (which results from emissions of VOC) is particularly important because Portland is in non attainment with ambient standards for these three pollutants.

A major reduction in emissions from motor vehicle exhaust has occurred since 1970 as older vehicles have been replaced by newer ones with factory installed emission controls mandated by federal law, and, to a lesser extent, because of DEQ's biennial vehicle inspection and maintenance program. Further reductions are projected to occur through 1987. Motor vehicle emissions of CO have dropped dramatically, from 1.2 million tons in 1970 to a projected 342,360 tons in 1987. Since motor vehicle emissions contribute 90% of total CO emissions, this has brought about a downward trend in concentrations of CO in the Portland area.

Motor vehicle emissions of VOC are projected to decrease from 54,203 tons/year to 15,474 tons/year between 1970 and 1987. Because these emissions account for only 53% of total VOC emissions, the reduction of total VOC emissions has not been as dramatic. As a result, a clear downward trend in ozone concentrations has not been evident (see Table 9.)

Motor vehicle exhaust is a relatively small contributor to TSP emissions (5%). However, road dust, which is largely stirred up by motor vehicle traffic, contributes 59% of total TSP emissions, and is increasing.

Motor vehicles with diesel engines now make up only 3-5% of the vehicle fleet in Portland, but a substantial increase in the number of diesels could significantly alter projected emissions of particulates from motor vehicles. Diesel engines emit 30-100 times as much TSP as a comparable gasoline engine, and 90% of these are respirable particulates, which are considered to have potentially harmful medical effects (41, 49, 55).

2. Industry. For most of the major pollutants in the Portland area, industry contributes considerably less to air pollution than motor vehicles, and in some cases, industry's contribution is less than such
sources as wood stoves. In 1980, industry accounted for only 8% of TSP emissions, 3% of CO, 22% of VOC (excluding gasoline vapors), 9% of NO\textsubscript{x}, 9% of lead, and 63% of SO\textsubscript{2}.

During the period from 1970 to 1987, the number of area employees in industrial manufacturing is expected to increase by 41%. However, industry's contribution to TSP emissions is projected to fall from 10,300 tons in 1970 to 3,000 tons in 1980. Further reductions between 1980 and 1987 are not expected to be significant. The change in industrial contributions to emissions of CO and VOC is expected to be relatively small.

One major industrial source of VOC emissions is the gasoline vapor which escapes from loading and unloading of fuel at bulk terminals, and from the transfer of gasoline from service station pumps to vehicle fuel tanks. These vapors account for 9,134 tons/year, about 15% of total VOC emissions (40, 41, 49).

3. Vegetative Burning. Vegetative burning, particularly in wood stoves, is an important and growing contributor to TSP and CO concentrations in the Portland area. Of the total emissions of TSP in 1980 (37,800 tons), 23% came from wood combustion in wood stoves and fireplaces, 1% from backyard burning, and 0.1% from field and slash burning.

Total TSP emissions are projected to increase from 37,460 tons in 1970 to 44,405 tons in 1987, an increase of 19%, despite the reduction in industrial emissions. During that period, the contribution from residential wood heating is expected to increase from 4,725 tons/year to 11,550 tons/year, an increase of 144%. Wood stoves are an important source of particulates because they produce 50-100 times as much TSP as a comparable residential oil furnace, due to incomplete combustion of fuel. Fireplaces are also an important source of TSP, but they produce only half as much pollution per cord of wood burned as wood stoves. The amount of wood burned in wood stoves is expected to grow from 20,000 cords/year to 340,000 cords/year in the 1970-1987 period. At the same time, wood burned in fireplaces is expected to drop from 220,000 cords/year to 140,000 cords/year. Wood stoves are especially important contributors to ambient air standard violations because their impact is very high during fall and winter months, when meteorological conditions are often most adverse.

Wood stoves are also a source of CO emissions. In 1980, 7% of total CO emissions came from residential wood heating. These emissions are projected to grow from 4,500 tons in 1970 to 79,000 tons in 1987 (41, 44, 49). As of April, 1983, woodstoves were not controlled by state or federal regulation.

IV. CURRENT PORTLAND AIR POLLUTION CONTROL PROGRAMS

A. Institutional Framework For Pollution Control

Many institutions directly or indirectly influence the establishment and implementation of air quality laws, regulations, policies and practices in the Oregon portion of the Portland-Vancouver Air Quality Maintenance Area. These range from the federal legislative, judicial and executive branches of government to local public bodies, citizen groups, and commercial enterprises. Those institutions specifically charged with developing
the policies and administering the programs to regulate air quality in Portland are subject to advice and pressure from a wide variety of sources. The following paragraphs briefly describe each of the organizations involved.

1. **Environmental Protection Agency (EPA).** The EPA is the federal agency charged with carrying out the requirements of the Clean Air Act. The Act assigns to the states the primary responsibility for implementation and enforcement. However, the EPA exerts great power over the states and selected industries through provisions establishing ambient air quality standards and emission standards, time limits for compliance, and special requirements such as offset policy and prevention of significant deterioration. The agency has latitude in many aspects of rulemaking. Flexibility also exists in the degree of implementation through such actions as staffing and enforcement decisions. Federal money for air quality projects is also distributed to the states through the EPA. The EPA's control is exercised through a regional office in Seattle and an Oregon Operations office located in Portland.

2. **Environmental Quality Commission (EQC).** The EQC is a state body whose mission is to establish the policies for the operation of the DEQ. Its responsibility includes establishing the policies and adopting the rules and standards under which the DEQ conducts the air quality management system in Oregon. The EQC is required to hold public hearings prior to adoption of such rules and standards. It is unique among the states, in that its authority is directive, rather than advisory. The five non-salaried members of the Commission are appointed by the Governor for four-year terms, subject to Senate confirmation. The Commission in turn appoints the director of the DEQ.

3. **Department of Environmental Quality (DEQ).** This state agency operates under the supervision of the EQC. Its responsibility is to conduct and operate environmental quality programs. Those programs dealing with air pollution control are operated by the Air Quality Division of DEQ, with headquarters in Portland. In brief, DEQ's air quality functions are to determine the degree of air pollution, encourage planning and performance by local institutions, seek enforcement of state laws, institute court action and compel compliance, conduct educational and demonstration programs, advise and consult with state and local agencies and the federal government, and conduct studies, investigations, and research. The Department sometimes relies on local institutions for performance of selected tasks. An example is the recent preparation of the state implementation plan for carbon monoxide by the City of Portland, assigned to the City through Metro.

4. **Metropolitan Service District (Metro).** Metro is an "umbrella" regional government whose geographic jurisdiction is roughly equivalent to the Oregon portion of the PAQMA. Due to its statutory responsibility for metropolitan aspects of transportation planning, Metro was designated by the Governor as primary agency for developing state implementation plans for ozone and carbon monoxide, which are largely related to vehicle emissions. To a lesser extent, the exercise of its designated responsibilities in the area of solid waste disposal influences air quality.

5. **Portland Air Quality Advisory Committee (PAQAC).** Unlike the above entities, PAQAC has no directive authority. It was an advisory group established by the Metro Council and DEQ under state statute to advise
on control strategies to attain and maintain state and federal air quality standards for CO, ozone and TSP, the pollutants for which Portland is in non compliance. PAQAC's task was completed with the adoption of three state implementation plans for CO, ozone and TSP. It was composed of 23 representatives of local agencies and institutions and the public at large. Three were non-voting members: representatives of the Washington Department of Ecology, the Southwest Washington Air Pollution Control Authority and the Clark County Regional Planning Council. The 20 voting members were all from Oregon. PAQAC's responsibilities included: ensuring that recommended control strategies were possible to implement, consistent with other state, regional and local goals and objectives; ensuring that consideration was given to such factors as the health, economic, social and energy impacts of those strategies; and fostering interstate coordination with the Southwest Washington region.

6. Other - Federal. Federal air quality standards and their implementation are affected by a host of interests other than those of the EPA. A few of these are the Congress, the White House in appointing EPA officials, the Justice Department in trying cases brought for violation, and special interest lobbies. The Executive Office's Council on Environmental Quality and the scientific organizations that contribute to standards information are other examples.

7. Other - State and Local Government. Such entities as the Oregon Department of Transportation and the counties and cities within the Portland AQMA give advice to responsible agencies such as DEQ and Metro on parking plans, street cleaning and sanding practices, road construction, traffic pattern planning, and rideshare and bicycling programs. The City employs an air quality planner in the Transportation Section of the Bureau of Planning.

The Department of Transportation, the City of Portland and the counties have made contributions to development of state implementation plans as members of the PAQAC. Individuals from different agencies frequently collaborate and consult on air quality issues.

Because of their influence on priorities for policy implementation and appointments, the direction and extent of local government effort in air quality issues is also significantly influenced by elected officials.

In Washington, at the state level, the Department of Ecology equates to Oregon's DEQ. At the local level, Washington agencies include the Southwest Washington Air Pollution Control Authority and the Clark County Regional Planning Council, Clark County and the cities within the air quality maintenance area.

The Bi-State Policy Advisory committee was formed by a joint resolution of Metro and the Clark County Regional Planning Council. The Advisory Committee is usually composed of elected officials and includes, for example, members of the city councils of Portland and Vancouver, commissioners of Multnomah and Clark Counties, and a member of the Metro Council and the Regional Planning Council of Clark County (RPC). The Committee's purpose is to provide a forum at which policy makers can discuss and attempt to resolve regional matters of mutual concern, and to develop recommendations for consideration by the Metro Council and the RPC.
8. **Local Citizens and Industry.** Non-governmental groups and individuals include a wide range of industries and citizen groups which influence, pressure and advise government agencies. Individuals and private concerns can voice their opinions directly to those in authority, but they are also present as pressure groups or through lobbyists. The PAQAC provided five membership positions for the public at large, and one each for the Port of Portland, the Western Oil and Gas Association, Associated Oregon Industries, the Oregon Environmental Council, the League of Women Voters, Tri-Met, and the Portland Chamber of Commerce.

B. **Management of Pollution Control Programs**

1. **Industrial Controls.** State and federal air quality regulations require that all air pollution sources use the "highest and best practicable treatment and control" available so as to "maintain overall air quality at the highest possible levels." In addition, the Clean Air Act provides for use of the "best available control technology" in areas which are in compliance with national ambient standards, and the "lowest achievable emission rate" in non-attainment areas. The aggregate national cost for control of industrial emissions between 1977 and 1986 will be an estimated $155 billion (39).

In practice, the technology required by these regulatory guidelines is quite effective. The level of control dictated by use of the "best available control technology" achieves a 99% reduction of TSP emissions (through use of electrostatic precipitators and fabric filters), and a 90% reduction of sulfur dioxide emissions (with limestone wet scrubbers and dry scrubbers) (57).

All major emission sources, whether new or existing, are required to obtain an Air Contaminant Discharge Permit from DEQ. Industrial sources are divided into 72 categories, with permit fees ranging from a total of $100 for surface coating manufacturers to $9,300 for aluminum and zirconium processors. The source operators are asked to negotiate a voluntary schedule with the DEQ staff for compliance with emission standards. If compliance is not achieved within 18 months, periodic reports of progress toward the goal are required. If an industrial source operator will not agree to a compliance schedule, the state can take steps to force compliance on a schedule determined by DEQ. Fines of up to $10,000 can be assessed to encourage compliance.

An existing plant cannot alter its operations in any way that increases emissions without first notifying DEQ and receiving a modified permit. Within 30 days of notifying DEQ of its plans, a new or modified source must submit detailed plans and specifications for air pollution control equipment, production processes, and nature of emissions. Unless the DEQ declares otherwise within 60 days, the plant can then begin operation according to these plans. To assure compliance, DEQ can conduct emission testing at the plant site, or can require the plant operator to perform the tests, keep records and report the results, according to prescribed testing methods.

State regulations also set allowable emission levels for major pollutants and hazardous air contaminants like asbestos, beryllium and mercury. Emission and performance standards are also defined for some particular types of industrial sources, including wigwam burners, rendering plants, pulp mills, lumber and plywood mills, aluminum plants, iron and steel plants, and fossil-fueled generators.
In addition to these broad requirements, there are special programs which apply to some industrial sources:

a) New Source Review. Operators of a proposed "major source" or "major modification" must submit to DEQ a more rigorous analysis of the emissions and their impact. A "major source" is defined as one which exceeds "significant emission" rates listed by DEQ. 

(For example, emission of 40 or more tons of sulfur dioxide (SO₂) per year is considered "significant." Therefore a source which exceeds this level of SO₂ emissions would be classified as a major source, subject to these requirements.) The required analysis must include: 1) an estimate of the amount and type of each air contaminant in terms of hourly, daily, seasonal and yearly rates; 2) an analysis of the impact on air quality considering meteorological and topographical data; and 3) an analysis of all other commercial, residential and industrial growth since 1978 in the area to be affected by the new source. In practice this type of analysis requires extensive use of computer modeling and detailed reports on the modeling.

Any major source operator applying for a new source permit must also prove that all other major sources in the state controlled by the same operator are in compliance with applicable emission rules. In other words, a company whose plant does not comply with emission requirements will not be given a permit to build a second plant until the first one is brought into compliance (71).

Any new major source emitting volatile organic compounds or carbon monoxide in a non-attainment area like Portland must conduct an analysis of alternative sites, production processes and environmental control techniques. The analysis must demonstrate that the benefits of the proposed new source significantly outweigh the environmental and social costs that result.

In addition to emissions directly related to manufacturers, regulations exist to control indirect sources of pollution generated by new industrial or commercial sources. Industrial or commercial operations which attract large numbers of automobiles are required to have an indirect source permit from DEQ. This requirement applies to new shopping centers or other new facilities with 250 or more parking spaces intending to locate in the Portland AQMA.

b) Offsets and Growth Increments. In areas of non attainment, room in the airshed for major new emission sources can be obtained in two ways:

1. Programs to reduce ambient pollution levels (all programs, including industrial controls, auto inspections, open burning restrictions, etc.) can be designed not just to reach the standard levels required by the Clean Air Act, but to lower pollution levels below these standards. The incremental difference between this planned pollution level and the allowable standard can then be allocated toward growth for industrial sources (33). Oregon is currently operating a "growth cushion" program for VOC emissions. Programs implemented or planned are expected to reduce VOC emissions by 1987 to a level 1,700 kg/day below the level needed to attain
the ambient ozone standard. DEQ plans to earmark this 1,700 kg/day of VOC emissions for new industrial sources (71).

2. An operator of a new major source can create offsets for the new emissions by reducing the emissions of other sources in the area. This can be done by purchasing pollution control equipment for a neighboring plant, by reducing emissions at another area plant owned by the same operator, or by creating reductions in area source emissions. These must be quantifiable and demonstrated to remain in effect for the life of the new source. These offset reductions must result in a net air quality benefit. That is, the total emission reduction must be greater than the amount of new emissions planned.

In addition, a source which reduces emissions to a greater extent than is required may "bank" the emission offset for up to 10 years. The offset can be used by the source operator for future expansion or can be sold to other operators. Reductions which are required to comply with other rules, or reductions achieved by permanent plant shutdowns are not eligible for banking.

2. Federal Motor Vehicle Emission Controls. The greatest contributions to emission reductions have come from federal programs that require manufacturers to produce motor vehicles which use unleaded gasoline and which meet stringent emissions standards. These programs have been responsible for most of the reductions of total CO by 50%, total VOC by 31%, total lead by 40%, and total NO\textsubscript{x} by an unspecified amount in the Portland AQMA from 1970 to 1980. They will be a major source of further reductions from 1981 to 1987 as older motor vehicles continue to be replaced by newer ones with more effective emission controls.

The 1970 Amendments to the Clean Air Act provided the authority for many of the federal programs that presently regulate the manufacture of motor vehicles. These amendments called for the EPA administrator to prescribe for 1975 and later model automobiles and light duty trucks federal emission standards that would effect a 90% reduction in CO and VOC emissions from 1970 levels. In addition, the administrator was to prescribe federal emission standards for 1976 and later model years that would effect a 90% reduction in NO\textsubscript{X} emissions from 1971 levels. The goal for NO\textsubscript{X} reduction was later reduced to 75%. The administrator was authorized to grant extensions and waivers to vehicle manufacturers to allow for new technology. Also, those amendments provided the authority for the EPA's subsequent prohibition of the use of leaded gasoline in automobiles with catalytic converters when they were introduced in the 1975 model year.

The 1977 Amendments to the Clean Air Act called for the EPA administrator to prescribe for heavy duty trucks federal emission standards requiring a 90% reduction in CO and VOC from uncontrolled levels beginning with the 1983 model year. Also, smoke and NO\textsubscript{X} are regulated for heavy duty trucks, and emissions standards are evolving for motorcycles and aircraft.

Implementation of final federal emissions standards for CO, VOC, and NO\textsubscript{X} from automobiles was delayed considerably from the original target years of 1975 and 1976 because of various administrative extensions and
waivers (see Table 10). During the 1975-1980 period, progressively more stringent interim standards were implemented. During the 1981-1982 period, final standards of 3.4 gm/mile for CO, 0.41 gm/mile for VOC, and 1.0 gm/mile for NO were implemented with the provision that waivers up to 7.0 gm/mile for CO and up to 2.0 gm/mile for NO could be obtained on a case-by-case basis. As of 1983, waivers were no longer in effect for CO, but were in effect for NO from diesels (up to 2.0 gm/mile for AMC and up to 1.5 gm/mile for other manufacturers).

The EPA has been slower to implement automobile emissions standards for TSP, presumably because motor vehicle exhaust contributes only a small portion to total TSP (5% in the Portland AQMA in 1980). However, diesel engine exhaust contains 30-100 times as much TSP, of which 90% is respirable, than gasoline engine exhaust. Hence diesels are a significant minority contributor of particulates and could become more important if the percentage of diesels in the motor vehicle fleet increases significantly or if the TSP standard is replaced by a fine particulate standard. Consequently, a particulate emission standard of 0.6 gm/mile TSP for automobiles was implemented by the EPA for 1982 and later model years. A more stringent TSP standard of 0.2 gm/mile was scheduled to be implemented for 1985 and later model years, but the EPA has proposed it be delayed until the 1987 model year.

From 1968 to 1974, automobile emissions standards were achieved by minor engine modifications. In 1975, single oxidation catalyst systems were added to most automobiles. By 1980, three-way catalyst systems (CO, VOC, NO) were required, as well as further engine modifications, including electronic control modules for numerous items. For diesels, the 1982 TSP standard was achieved by minor engine modifications, but the 1987 standard will be more difficult to meet because of the need to develop and test more sophisticated anti-pollution devices.

According to EPA estimates (in 1977 dollars) the cost for the modifications to gasoline engines are gradually increasing as more stringent controls are being phased in. The cost per automobile for emission reduction equipment was estimated to be $5-87 for 1968-1974 model years, $320-335 for 1975-1979 model years, and $439-495 for 1980-1986 model years. There appears to have been a temporary increase in fuel consumption. As a result, vehicle mileage decreased by up to 1.7 miles/gallon between 1968 and 1973, then returned to the precontrolled state. Fuel cost increases due to the lead-free gasoline requirement were estimated to be gradually increasing from 1 cent/gallon in 1975 to 2.5 cents/gallon in 1986.

The aggregate national cost to the public for these regulations of motor vehicle emissions (in 1977 dollars) was estimated to be $38.2 billion from 1970 to 1977 and $92.0 billion from 1977 to 1986 (39, 41, 42, 68, 69).

3. Vehicle Inspection/Maintenance Program. In 1975, the Oregon legislature passed a law requiring a biennial auto emission control inspection program. The law requires that vehicles registered in the metropolitan area show evidence of compliance with emission control requirements prior to license renewal. The program operated on a voluntary basis during 1974 and 1975, and became mandatory on July 1, 1975.

DEQ operates seven motor vehicle emission inspection centers and one mobile unit. A total of $3.4 million is budgeted for the 1981-83
The function of an inspection/maintenance test is to identify those vehicles which pollute excessively and need remedial maintenance. While new vehicles must meet stringent emission reduction standards when they leave the factory, these pollution control systems, like other vehicle equipment, require regular maintenance to keep them operating at peak efficiency. In Portland, the test fails approximately 35% of all cars and identifies 80% of the vehicles emitting CO and VOC in excess of federal emission standards.

DEQ augments its inspection program with a fleet program which allows licensed fleets to self-inspect their own vehicles. There are currently 45 licensed self-inspection fleets. To qualify, a company or government agency must have approved exhaust analysis equipment and its employees must complete a DEQ-operated training session.

The findings of an EPA study indicate that the Portland inspection program achieved emission reductions of 34% for CO and 24% for VOC in 1975-77 model cars over a one-year period. The program is projected to be sufficient to achieve the EPA's minimum requirement of a 25% reduction in both CO and VOC emissions by December 31, 1987 (36).

4. Parking Restrictions. The transportation element of the Portland Downtown Plan, which was adopted in 1972, calls for the development of a parking and circulation plan to facilitate the reduction of automobile travel, to improve vehicular circulation, and to increase mass transit use and pedestrian and bicycle travel in the core area. The resulting Downtown Parking and Circulation Policy was adopted in 1975.

The most prominent feature of this policy was the adoption of a limit of approximately 39,000 on the number of vehicular parking spaces permitted. This was based on an inventory of the existing and committed spaces. The policy also provides for a review of the parking lid every three years to assure that it is consistent with the Downtown Plan's goal of continued economic vitality in the core area (48).

The number of downtown parking spaces has remained fairly stable since 1975 as the construction of new spaces has offset the loss of others. There has been a significant reduction in the number of curb spaces with a corresponding increase in the spaces in off-street garages. There has also been a shift of available spaces from some segments of the core area to other segments.

The state implementation plan for carbon monoxide includes continuation of the parking lid, with a maximum level of 40,855 spaces. The city parking manager is required to update the inventory of available spaces on a regular basis.

5. Transportation-Related Programs

a. Auto-related programs. Transportation strategies for the Portland area include many steps aimed at reducing congestion and speeding the flow of traffic. As these goals are met, auto emissions are reduced as well because of shorter total running time for automobile engines and because of less time spent idling. Strategies implemented to achieve these ends include:
Ramp Metering — Ramp metering was established on I-5 North between Portland and Vancouver in January, 1981. The meters have reduced afternoon peak-hour travel times by 50% and hydrocarbon emissions have been lowered by approximately 100 kilograms per day. Ramp meters will also be installed on the Banfield Freeway as part of freeway construction that accompanies building of the Banfield Light Rail Line. Metering is being studied for the Sunset Highway, I-5 South to Tigard, and I-205.

Traffic Signal Computerization — Computerized traffic signals have been instituted on several major arterials and the Transit Mall. The City of Portland has developed a five-year program to interconnect signals on a citywide basis with a goal of reducing stops and delays by 15%. The program is scheduled to be fully implemented by 1986.

Highway Improvements — A number of construction projects are planned to improve traffic flow on Portland area roads. Included are reconstruction of the I-5 freeway interchange near the Columbia River and construction of a new Slough Bridge, circulation improvements in the Hollywood area, an Oregon City bypass, improvements of the Yeon/Vaughn corridor in Northwest Portland, and improvements to McLoughlin Blvd. Although these projects are listed in current plans, funding for some of them is not yet available.

Other Reductions in Vehicle Miles Traveled — Metro adopted a Regional Transportation Plan in June, 1982 to serve as a guide for transportation planning until the year 2000. It sets objectives of minimizing travel by single-occupant autos, minimizing travel during peak hours, and minimizing trip length. The plan, when fully implemented, envisions an 8% reduction in vehicle miles traveled with 35% of all work trips taken in carpools by 2000 (70, 71).

b. Pedestrian and Bicycle Programs. The 1971 legislature authorized spending not less than 1% of state highway funds on bicycle trails and footpaths. Since then, 74 miles of bikeways have been developed in the Portland area. The City's goal is to have 100 miles of designated bike paths in the city by 1985 and to have 5% of all work trips made by bicycle. An experimental project is under way in which the city is working with 20 employers in the area to establish bicycle commuting plans for employees (70, 71).

c. Flex Time Programs. Tri-Met and the City of Portland began an 18-month program in January, 1982 to assist businesses in adopting flexible working hours for employees. This would spread travel to and from work over more hours of the day, thus reducing congestion at morning and evening peak times.

d. Street Sweeping and Cleaning. In 1981, the City of Portland began a demonstration program of daily vacuum sweeping of streets in two areas of Northwest Portland. The project is an attempt to determine the effect of such a cleanup on road dust in the air. However, it is not yet possible to tell whether the program is effective in improving particulate air quality.
The Oregon Department of Transportation has altered winter road sanding practices in the metropolitan area in hopes of reducing particulate pollution caused when sand is stirred into the air by passing vehicles. The Department of Transportation now uses cleaner, larger grade sanding materials and attempts are made to clean up the sand quickly after weather conditions improve.

6. Transit and Rideshare Programs. Like restrictions on downtown parking, programs to increase use of mass transit and ridesharing are aimed at reducing the number of single-occupant auto trips into the core area, where concentrations of pollutants are often highest. These programs focus on work trips because they constitute the largest percentage of downtown trips. In addition, shifting employees from single-occupant autos to other modes frees limited core area parking for use by shoppers and other short-term visitors to downtown.

a) Programs to Increase Mass Transit Use. The programs of Tri-Met and Metro to develop greater use of mass transit have been undertaken as part of transportation planning efforts for the region. By increasing the percentage of trips made by transit, the number of auto trips is reduced, relieving congestion and slowing the need for new highway construction in the urban area. In addition to these benefits, however, reducing the number of auto trips also has a positive impact on air quality. Hence, transit improvements have also become a factor in air quality planning for the area.

Despite a dramatic growth in downtown employment and office space between 1976 and 1979, average downtown traffic volume did not show a marked increase, fluctuating only about 10% between 336,000 and 369,000 vehicles a day. In July, 1979, the last year for which data is available, 367,000 vehicles were reported entering and leaving the core area daily.

According to a recent consultant's study published by the City's Bureau of Planning, the volume of average weekday traffic to and from downtown is not expected to increase appreciably in the future because (a) congestion and capacity limitations on segments of the major freeway system constrain access to the downtown area, especially during peak hours, and (b) travel requirements generated by continued downtown growth can continue to be absorbed by the public transit system (48).

Tri-Met has made substantial improvements in service during recent years. Since 1969, average workday transit ridership has increased 230%. Although a decrease was experienced beginning in 1981 due to a reduction in gasoline prices, two fare increases, and very congested peak-hour buses, the trend over the past six years shows a major increase in ridership (70, 71).

Major steps taken to improve transit service have included: completion in 1975 of the 22-block downtown transit mall; establishing Fareless Square which allows free rides within the downtown area; purchase of 262 new buses to enlarge the fleet and increase service; and development of better transit service in the congested freeway corridors between Portland and Vancouver.
### Table 1

**POLUTANT STANDARD INDEX (PSI) AS OF JANUARY 1980**

<table>
<thead>
<tr>
<th>Index</th>
<th>Air Quality</th>
<th>Pollutant Concentrations (a)</th>
<th>TSP</th>
<th>SO₂</th>
<th>CO</th>
<th>O₃</th>
<th>NO₂</th>
<th>Description (b,c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>Significant harm</td>
<td>1.000</td>
<td>1.0</td>
<td>50</td>
<td>0.6</td>
<td>2.0</td>
<td>Hazardous</td>
<td></td>
</tr>
<tr>
<td>400</td>
<td>Emergency</td>
<td>875</td>
<td>0.8</td>
<td>40</td>
<td>0.5</td>
<td>1.5</td>
<td>Hazardous</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td>Warning</td>
<td>625</td>
<td>0.6</td>
<td>30</td>
<td>0.4</td>
<td>1.2</td>
<td>Very unhealthful</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>Alert</td>
<td>375</td>
<td>0.3</td>
<td>15</td>
<td>0.2</td>
<td>0.6</td>
<td>Unhealthful</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>Standard</td>
<td>260</td>
<td>0.14</td>
<td>9</td>
<td>0.12</td>
<td></td>
<td>Good or moderate</td>
<td></td>
</tr>
</tbody>
</table>

- **a** TSP (total suspended particulates) in ug/m³; other concentrations in ppm.
- **b** Averaging times, 24 hours for TSP and SO₂, eight hours for CO, one hour for O₃ and NO₂.
- **c** For pollutant concentrations between the indicated air-quality level and the next lower level.

Unhealthful: Persons with existing heart or respiratory ailments should reduce their physical exertion and outdoor activity.

Very unhealthful: The elderly and persons with existing heart or lung disease should stay indoors and reduce their physical activity.

Hazardous: At the emergency level, the elderly and persons with existing diseases should stay indoors and avoid physical exertion; the general population should avoid outdoor activity. At the significant-harm level, all persons should remain indoors, keeping windows and doors closed; all persons should minimize their physical exertion and avoid traffic.

Table 2

AMBIENT AIR QUALITY STANDARDS FOR OREGON

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Averaging Time</th>
<th>Federal Standards</th>
<th>Oregon Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Primary (Health)</td>
<td>Secondary (Welfare)</td>
</tr>
<tr>
<td>Total Suspended</td>
<td>Annual Geometric Mean</td>
<td>75 µg/m³ (1) 60 µg/m³</td>
<td>60 µg/m³</td>
</tr>
<tr>
<td>Particulate (6)</td>
<td>24 hours (3)</td>
<td>260 µg/m³</td>
<td>150 µg/m³</td>
</tr>
<tr>
<td></td>
<td>Monthly (4)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ozone (6)</td>
<td>1 hour</td>
<td>235 µg/m³ (5)</td>
<td>235 µg/m³ (5)</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>8 hours (3)</td>
<td>10 mg/m³ (2)</td>
<td>10 mg/m³</td>
</tr>
<tr>
<td></td>
<td>1 hour (3)</td>
<td>40 mg/m³</td>
<td>40 mg/m³</td>
</tr>
<tr>
<td>Sulfur Dioxide</td>
<td>Annual Arithmetic Average</td>
<td>80 µg/m³</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>24 hours (3)</td>
<td>365 µg/m³</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>3 hours</td>
<td>-</td>
<td>260 µg/m³</td>
</tr>
<tr>
<td>Nitrogen Dioxide</td>
<td>Annual Arithmetic Average</td>
<td>100 µg/m³</td>
<td>100 µg/m³</td>
</tr>
<tr>
<td>Hydrocarbons (Nonmethane)</td>
<td>3 hours (3) (6-9 a.m.)</td>
<td>160 µg/m³</td>
<td>160 µg/m³</td>
</tr>
<tr>
<td>Lead</td>
<td>Calendar Quarter</td>
<td>1.5 µg/m³</td>
<td>1.5 µg/m³</td>
</tr>
</tbody>
</table>

NOTES:
1. µg/m³ = Micrograms of pollutant per cubic meter of air (microgram = 1/1000 milligram)
2. mg/m³ = Milligrams of pollutant per cubic meter of air (milligram = 1/1000 gram)
3. Not to be exceeded on more than one day per year.
4. 24-hour average not to be exceeded for more than 15 percent of the samples in a calendar month.
5. A statistical standard, but basically not to be exceeded more than an average one day per year based on the most recent three years of data.
6. The state standard was revised on January 22, 1982.

Source: 1981 Air Quality Annual Report, DEQ.
Table 3

# days above
primary standard level

<table>
<thead>
<tr>
<th>Level (10 mg/m³)</th>
<th>CO - DOWNTOWN PORTLAND</th>
<th>CO - HOLLYWOOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>180</td>
<td></td>
<td></td>
</tr>
<tr>
<td>140</td>
<td></td>
<td></td>
</tr>
<tr>
<td>120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CO - DOWNTOWN PORTLAND

CO - HOLLYWOOD

YEARLY OZONE-CARUS

TSP - DOWNTOWN PORTLAND

*mg/m³ = milligrams per cubic meter
ug/m³ = micrograms per cubic meter

Source: Compiled by the Committee from data collected by DEQ.
Table 4

CO-DOWNTOWN PORTLAND
1981

ambient
daily concentrations
(8-hour average)
mg/m³

* mg/m³ = milligrams per cubic meter
Table 5

CO-HOLLYWOOD AREA

1981

*mg/m^3 = milligrams per cubic meter
Table 6

OZONE-CARUS
1981

ambient daily concentrations
(1-hour average)
ug/m³

* ug/m³ = micrograms per cubic meter
Table 7

TSP PORTLAND CENTRAL FIRE STATION 1981

primary standard

ambient daily concentration
(24-hour average)
ug/m³

secondary standard

* micro grams per cubic meter
Table 8

**MAJOR SOURCES OF AIR POLLUTION IN PORTLAND AQMA (OREGON PORTION) 1980-81**

<table>
<thead>
<tr>
<th>Pollutants in Noncompliance</th>
<th>Pollutants in Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TSP</strong></td>
<td></td>
</tr>
<tr>
<td>Road Dust - 59%</td>
<td>Industry - 63%</td>
</tr>
<tr>
<td>Residential wood combustion - 23%</td>
<td>Motor Vehicles - 14%</td>
</tr>
<tr>
<td>Industry - 8%</td>
<td>Other - 23%</td>
</tr>
<tr>
<td>Motor Vehicle exhaust - 5%</td>
<td></td>
</tr>
<tr>
<td>Other - 5%</td>
<td></td>
</tr>
<tr>
<td><strong>CO</strong></td>
<td></td>
</tr>
<tr>
<td>Motor Vehicles - 90%</td>
<td>Motor Vehicles - 84%</td>
</tr>
<tr>
<td>Wood Stoves - 7%</td>
<td>Industry - 9%</td>
</tr>
<tr>
<td>Industry &amp; Others - 3%</td>
<td>Others - 7%</td>
</tr>
<tr>
<td><strong>NOx</strong></td>
<td></td>
</tr>
<tr>
<td>Motor Vehicles - 53%</td>
<td></td>
</tr>
<tr>
<td>Industry &amp; Commerce - 22%</td>
<td></td>
</tr>
<tr>
<td>Bulk &amp; Service Station Gas - 15%</td>
<td></td>
</tr>
<tr>
<td>Others - 10%</td>
<td></td>
</tr>
<tr>
<td><strong>VOC</strong></td>
<td></td>
</tr>
<tr>
<td>Motor Vehicles - 68%</td>
<td>Motor Vehicles - 68%</td>
</tr>
<tr>
<td>Industry &amp; Others - 9%</td>
<td>Paved road dust - 23%</td>
</tr>
</tbody>
</table>

*Source: DEQ Emission Inventories, 1980 and 1981*
Table 9

TOTAL EMISSIONS IN PORTLAND AQMA
FOR 1970, 1980 and 1987 (PROJECTED)

Source:
Compiled by the Committee based on DEQ Emission Inventories and personal communication from Merlyn Hough, Medford-Ashland AQMA Coordinator, DEQ.
### Table 10

**FEDERAL EXHAUST EMISSION STANDARDS AND CONTROL LEVELS FOR AUTOMOBILES SINCE 1973**

Emission levels in grams/mile

<table>
<thead>
<tr>
<th>Year</th>
<th>Emission</th>
<th>Gasoline automobiles</th>
<th>Diesel Automobiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973-1974</td>
<td>VOC</td>
<td>3.0</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>CO</td>
<td>28.0</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>NO\textsubscript{x}</td>
<td>3.1</td>
<td>—</td>
</tr>
<tr>
<td>1975-1976</td>
<td>VOC</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>CO</td>
<td>15.0</td>
<td>15.0</td>
</tr>
<tr>
<td></td>
<td>NO\textsubscript{x}</td>
<td>3.1</td>
<td>3.1</td>
</tr>
<tr>
<td>1977-1979</td>
<td>VOC</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>CO</td>
<td>15.0</td>
<td>15.0</td>
</tr>
<tr>
<td></td>
<td>NO\textsubscript{x}</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>1980</td>
<td>VOC</td>
<td>0.41</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>CO</td>
<td>7.0</td>
<td>18.0</td>
</tr>
<tr>
<td></td>
<td>NO\textsubscript{x}</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>1981-1982</td>
<td>VOC</td>
<td>0.41</td>
<td>0.41</td>
</tr>
<tr>
<td></td>
<td>CO</td>
<td>3.4*</td>
<td>3.4*</td>
</tr>
<tr>
<td></td>
<td>NO\textsubscript{x}</td>
<td>1.0#</td>
<td>1.0#</td>
</tr>
<tr>
<td>1983 and after</td>
<td>VOC</td>
<td>0.41</td>
<td>0.41</td>
</tr>
<tr>
<td></td>
<td>CO</td>
<td>3.4</td>
<td>3.4</td>
</tr>
<tr>
<td></td>
<td>NO\textsubscript{x}</td>
<td>1.0#</td>
<td>1.0#</td>
</tr>
</tbody>
</table>

*1981 and 1982 CO standards can be waived to 7.0 grams/mile.

# 1981, 1982, and 1983 NO\textsubscript{x} standards can be waived to 2.4 grams/mile.

Table 11

POTENTIAL FUTURE VOC REDUCTIONS FROM SOURCES IN THE PORTLAND AREA
1987

<table>
<thead>
<tr>
<th>Source</th>
<th>Reduction (kg/day)</th>
<th>Annual Cost For Each kg/day Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Stationary Sources (Some Cost, Feasibility Data Available)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Service Station Unloading (stage II)</td>
<td>4,440</td>
<td>$177/kg/day</td>
</tr>
<tr>
<td>2. Paper Coating, Best Available Control Technology changes</td>
<td>3,660</td>
<td>$7/kg/day</td>
</tr>
<tr>
<td>3. Wood Furniture Coating</td>
<td>negligible</td>
<td></td>
</tr>
<tr>
<td>4. Architectural Coatings</td>
<td>6,200</td>
<td>savings?</td>
</tr>
<tr>
<td>5. Auto Refinishing</td>
<td>negligible</td>
<td></td>
</tr>
<tr>
<td>6. Dry Cleaning, Stoddard solvent control</td>
<td>386</td>
<td>$31/kg/day</td>
</tr>
<tr>
<td><strong>B. Stationary Sources (Little Cost, Feasibility Data Available)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Gasoline Vapor from Barge Loading</td>
<td>2,583</td>
<td>$130/kg/day</td>
</tr>
<tr>
<td>2. Paper Coating, Lowest Available Emission Rate changes beyond Best Available Control Technology</td>
<td>8,800</td>
<td>$19/kg/day</td>
</tr>
<tr>
<td>3. Other Solvent Use, Ethanol from bakeries</td>
<td>4,200</td>
<td>$56/kg/day</td>
</tr>
<tr>
<td><strong>C. Transportation Sources</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Transit Development</td>
<td>690</td>
<td>$38,800/kg/day</td>
</tr>
<tr>
<td>2. Oregon Ramp Metering</td>
<td>485</td>
<td>benefit</td>
</tr>
<tr>
<td>3. Park and Ride</td>
<td>56</td>
<td>$24,900/kg/day</td>
</tr>
<tr>
<td>4. Annual Inspection/ Maintenance</td>
<td>5,940</td>
<td>a) $2,100/kg/day (no mechanics training)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) $93/kg/day (with mechanics training)</td>
</tr>
<tr>
<td>5. Bicycling</td>
<td>470</td>
<td>benefit</td>
</tr>
<tr>
<td>6. Free Fare Transit/Off Peak</td>
<td>370</td>
<td>benefit</td>
</tr>
</tbody>
</table>

Source: Compiled from METRO Technical Memorandum #37, Cost-Effectiveness of Transportation/Air Quality Control Measures, April 1981.
One major improvement in transit service yet to be realized is construction of a light rail transit route from Gresham to downtown Portland along the Banfield corridor. Work on the project began in September, 1982 and is planned for completion in 1986. This project is part of a five-year Transit Development Plan which includes route and schedule improvements and location of transit centers throughout the area. If all aspects of the plan are implemented, 1987 levels of transit service would be nearly double existing levels. Transit ridership would be expected to increase from 150,000 in 1980 to 315,000 in 1987. Light rail projects are also being considered for a westside route to Beaverton and a route along the McLoughlin corridor to Milwaukie. However, except for the Banfield Light Rail line, funding for these improvements is not assured (70, 71).

b. Ridesharing Programs. Tri-Met and Metro operate programs to reduce the number of single-occupant auto trips by combining the trips in carpools and vanpools. Tri-Met operates a carpool matching service, makes employer contacts and develops promotional campaigns to increase carpooling. It is estimated that about 8% (50,000) of the tri-county population now commutes in carpools of three or more people. An additional 68,000 persons ride in two-person carpools. Of these two groups, 6,000 have been placed in carpools by Tri-Met's matching service (70, 71).

Other programs to encourage ridesharing have included: reserving 500 six-hour parking meters in the downtown area for use by carpools which purchase a monthly parking permit; priority lanes for carpools and buses on major highways, such as those in existence from 1975-1982 on the Banfield Freeway; special projects to increase carpool use in congested travel corridors, such as I-5 between Vancouver and Portland or McLoughlin Blvd. between Oregon City and Portland; adoption of legislation which limits the liability of employers who arrange carpools for employees; special programs with about 250 large employers in the area to arrange specially designed transportation packages combining carpools, vanpools and transit for employees.

The City of Portland's Swan Island project, funded by a federal Air Quality Technical Assistance Demonstration Grant, focused on reducing auto travel in a single, large industrial area with the specific goal of making further industrial development possible through pollution reduction. The project combined improved transit service to Swan Island, an intensive marketing campaign, a free bus pass promotion and preparation of Employee Transportation Plans by selected firms on the island. Transit ridership in the area increased 92% during the study. Traffic levels decreased 14% while day shift employment rose 11%. Carbon monoxide and particulate levels were reduced (75).

7. Educational Programs. Because of the importance of individuals' contributions to pollution, public knowledge of air quality issues is an important factor in reducing air pollution. As environmental awareness grew in the early 1970s, coverage of pollution issues in print and broadcast media was extensive, and it is from these sources that many people still receive most of their information about air quality is-
sues. Because of the public interest, policy decisions by the EQC, and emission control programs of DEQ and other agencies do get coverage in the local press.

To augment this information, DEQ employs a public affairs staff of five to prepare printed material and answer inquiries from the press and interested citizens. One of the five staffers is assigned full-time to work with air quality information. DEQ has devoted particular attention to increasing public awareness of pollution problems which result from residential wood heating and backyard burning.

An annual air quality report for public dissemination is prepared by DEQ describing the current status of air quality programs in the state and including a statistical summary of pollution monitoring results around the state. The most recent annual report contained a special section on the pollution impact of wood heating.

The only DEQ funding devoted exclusively to providing the public with air quality information is the salary for the staff person assigned to that position and a $10,000 EPA grant for publication of the "Wood Heat Handbook." This pamphlet describes how to select a wood stove and includes information about wood stove safety, efficiency and pollution. There is a limited budget available for publication of other printed material. In recent years, some state funding was also available for developing video and audio presentations on air pollution issues. However, shortfalls in state revenue have eliminated the funds for these efforts. The governor's proposed budget for the next biennium continues funding for DEQ public affairs activity at about current levels. If additional budget cuts become necessary, one half-time position on the public affairs staff may be eliminated (10).

While other state, regional and local agencies have not developed specific programs for public education about pollution issues, some of their information programs do have an indirect impact on air quality. Projects by Tri-Met and Metro to encourage ridesharing, bicycling and use of mass transit benefit air quality by reducing auto traffic and congestion. The City of Portland has printed an "Air Quality Handbook" for all of its employees outlining basic information about pollution in Portland in the hope that air quality concerns will be kept in mind by City policy makers.

8. Backyard Burning. The open burning of yard debris is among the most controversial sources of particulate pollution in the Portland area. Precise impacts of this practice on air quality are not known because of the lack of monitoring sites in residential areas where most burning occurs, and because of the similarity between yard debris smoke and smoke from wood stove use. Most major cities across the country have banned backyard burning. However, burning is still permitted in Portland, with restrictions.

The Columbia-Willamette Air Pollution Authority (CWAPA) adopted a plan in the 1960s to phase out open burning in the metropolitan area, beginning with industrial and commercial sources. A ban on residential backyard burning was imposed by CWAPA in 1970, but public outcry forced the agency to alter the rules to allow spring and fall burning seasons, with burning limited only to days with adequate ventilation to disperse the smoke. These burning seasons have continued ever since, primarily because there were no alternative methods of disposal.
In December, 1980, the EQC voted unanimously to ban open burning of yard debris in the Portland area beginning in January, 1981. Despite a survey which had found area residents 2 to 1 in favor of a burning ban, if collection and disposal methods were available, substantial public and political opposition to the ban developed almost immediately. The 1981 legislature considered, but did not pass, legislation which would have permanently prohibited EQC from banning backyard burning. A bill approved by the legislature placed a temporary halt to the burning ban. The new legislation allowed EQC to institute a burning ban after June 30, 1982 if it was found that: 1) a ban was necessary to meet air quality standards; and 2) alternative disposal methods were "reasonably available to a substantial majority of the affected population." In light of this opposition, the EQC voted to rescind the ban at a meeting in March, 1981.

Programs have been underway to develop alternative disposal methods. Metro began a demonstration program in 1981, funded by a grant from EPA, to evaluate possible systems for collecting and processing yard debris. Ten neighborhood cleanup projects were conducted in the City of Portland in which yard debris was taken by the public to a central location, segregated into drop boxes and transported to a processing site. In Clackamas County, garbage collection franchise ordinances are being altered to address collection of yard debris in the county's unincorporated areas. Beaverton, Oregon City, Gladstone, West Linn, Lake Oswego and Troutdale have implemented or tested yard debris collection systems (80).

Four locations for collecting and processing yard debris into useable fuel and mulch have been established by private firms in the area. These centers would have the capacity to process over 400,000 cubic yards of debris annually (80). A 1980 DEQ survey indicated that 80,000 to 100,000 cubic yards per year were being burned by area residents while an additional 400,000 cubic yards per year were being deposited in area landfills. Therefore, the developing debris processing system eventually should be able to accommodate all of the debris now being burned as well as some of the debris that has been filling critically short landfill space (74).

The Metro Yard Debris Steering Committee, made up of representatives of local jurisdictions, met in June, 1982 to address the issue of whether alternative disposal methods are "reasonably available." The steering committee's final report was published in March, 1983 (see full discussion in Section V., H).

V. DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

A. Introduction

It has been nearly two decades since the first federal Clean Air Act in 1963, and the State of Oregon is a long way into the process of implementing air pollution controls. In general, the air quality in Portland is quite good. Major progress has been made in reducing carbon monoxide which was the main pollution problem affecting this area. However, there continues to be a small number of violation days for the CO and ozone primary, and the TSP secondary standards. The current state implementation plans appear to make attainment of federal standards by 1987 feasible, especially in view of the recent slow down in the general economic growth of the region.
Your Committee did not evaluate the nationwide impact of air quality regulation on economic development. It would appear that the overall economic health of Oregon and the Portland area, in comparison with other states and metropolitan areas, has not been adversely affected by air quality legislation. In fact, the area's image of good overall air quality may have been a positive factor in past economic and population growth for this area. Your Committee found no convincing evidence that air quality controls by themselves were an economic deterrent at the state level (see Section V, E).

Many of the issues involved in air quality are both complex and controversial. The Committee found it impossible to cover every aspect and ramifications of all such issues in this report. A decision was made to address those issues which seemed of major concern to the community and might have the greatest impact on it. Conclusions and recommendations are presented at the end of each issue section.

A number of the strategies, many of them transportation-related, which have a smaller or subsidiary effect on air quality and are included in Oregon's state implementation plans, are described in Section IV, B. Although your Committee generally supports the implementation of these programs, we have chosen to discuss in this report strategies expected to play an important role in reducing air pollution in Portland in the near future.

While the charge to the committee included taking into account potential physical degradation to structural forms and natural systems, your Committee was not presented with evidence that any of these potentially serious environmental problems was present in the Portland AQMA due to air pollution. Since acid rain is not considered a potentially serious problem in the Northwest, this issue will not be discussed despite its seriousness elsewhere in this country. Also, we were unable to answer important questions such as, "Is the public health of the Portland area currently better due to improvements already achieved in air quality?" due to the lack of any available data.

B. **Federal Air Quality Standards - Discussion**

Federal air quality standards were set at levels intended to protect even sensitive groups and to allow a margin of error below lowest levels known to cause significant disease or harm. While it is possible to determine levels at which risks are unacceptably high, it is difficult to determine at what level risks become insignificant. Consequently, in setting standards it was necessary in large part to extrapolate from an area of measurable high-level risks to an area of uncertainty where low level or absent risks cannot be measured precisely. It also may be impractical or impossible to achieve a state of "no risk" as opposed to "acceptable risk." Government, industry, and private citizens routinely accept some risk of disease and even death in many activities, often for purely economic benefits. For example, federal laws mandating manufacture of automobiles with better gas mileage have strongly encouraged a trend toward smaller cars, even though this trend could result in thousands of additional deaths from auto accidents annually.

Congress dealt with the problems inherent in the standard setting process by asking committees of the National Academy of Sciences to study all available information on the health effects of air pollution. The EPA then used the findings of these committees as the basis for the present air quality standards. Because of the limitations of available data, even ex-
experts are prevented from rigorously determining if current standards provide an adequate margin of error. Your Committee has neither the resources nor the expertise to evaluate fully the margin of error provided by current standards. A cursory examination, however, has indicated that the process used for determining these standards enjoys general support. Witnesses stated that most experts agree that the standards are the best that can reasonably be achieved given an imperfect information base. The National Academy of Sciences (NAS) is generally viewed as the nation's most respected and prestigious body for review of scientific material. In fact, the process of utilizing a NAS review of relevant scientific information is used frequently in federal policy making, whenever policy decisions must be made on highly technical subjects (e.g., nuclear power, medicine). It appears that given the attendant uncertainty in judging the level at which harmful effects result from air pollution, the EPA chose the seemingly prudent approach of erring on the side of caution.

In view of the complexity of the standard-setting process and the concept of relative risk, those who would propose substantial changes in air quality standards should do so with caution. Even so, a program costing billions of dollars annually, which is based upon standards generated in a climate of scientific uncertainty, may not have been perfect upon first implementation. Since available data on the health effects of air pollution was expected to improve with time, the law clearly states that each standard must be re-evaluated periodically and must be revised if new scientific information so dictates. Fine tuning of the standards may be necessary and, perhaps even expected, particularly if it is firmly based on emerging scientific and economic data.

The national ambient air quality standards are a critical element of efforts to control air pollution, since nearly all other programs and regulations are established with these standards as a basis. Compliance with the standards is the goal which most control programs seek to achieve. Progress toward meeting the standards is the common measuring stick for determining the success of these efforts.

As a result, it is nearly impossible to evaluate existing and proposed regulatory programs without first assessing the appropriateness of the national ambient standards. As stated, this is not a task for which your Committee was equipped. However, given the general support expressed by witnesses for the existing standards, it seems appropriate to utilize the national ambient standards as a broad, albeit imperfect, definition of acceptable pollution levels, not to be exceeded. In addition, progress toward meeting these standards can be used as a reasonable measurement of the effectiveness of control programs. This is the approach your Committee has taken in reviewing air quality management in the Portland area.

1. Conclusions

a) The process by which the National Ambient Air Quality Standards were set appears to be adequate.

b) The resultant Ambient Air Standards provide adequate protection for the public, particularly when relative risks and difficulty in measuring low-level effects are considered.

c) The public should expect and be encouraged to accept adjustments in these standards based on emerging scientific information.
d) Oregon can provide adequate protection for the public health by implementing only those control programs necessary to meet National Ambient Air Quality Standards.

e) Additional control programs, not necessary for protection of public health, may be desirable to prevent the significant deterioration of current air quality, or when factors such as nuisance abatement or improvement of traffic flow are the major considerations. Moreover, further controls may become necessary to allow for economic growth in the region (see discussion in Section V., E).

C. Proposed Relaxation of Federal Standards – Discussion

A heated debate was waged in the 1982 Congress over whether some Clean Air Act standards, particularly auto emission standards, should be relaxed. Although the debate reached a stalemate during the 97th Congress, some action will be required this year (1983) since major portions of the Act have expired.

One of the proposals put forth by General Motors was that National Air Quality Standards be permitted to be exceeded five days a year rather than just one or two, as is now permitted, before an area is considered in non attainment. Others sought to do away with inspection/maintenance programs and to delay implementation of high standards. In addition to these efforts, new issues not addressed under the existing Clean Air Act have emerged. The most important of these are the acid rain problem and diesel engines. In the atmosphere of political tradeoffs and compromise that affect the making of federal law, it was reported to your Committee in 1982 by Rep. Ron Wyden (D-OR) that attempts to reach a compromise on national and international problems such as acid rain control might raise arguments to relax certain standards, such as auto emissions of CO, in exchange for legislation to control acid rain. This sort of compromise would affect the Portland airshed, which is now not affected by acid rain, if in exchange for legislation controlling the latter, more CO (or VOC) were allowed to enter the airshed.

Changes in the federal standards pertaining to ambient air quality would have significant implications for Oregon. Since the Portland AQMA has made significant progress toward meeting standards, any relaxation of these standards would allow this area to reach attainment with fewer and less restrictive strategies, and would allow for a larger growth cushion. Any relaxation might also increase our average pollution levels, as would the changing of the definition of non attainment from the current two violation days to as many as five days annually. Since Portland's violation days are usually sharp peaks associated with adverse meteorologic conditions, this would make it considerably easier to be in attainment. Although Portland's average values for most pollutants are quite good, it must be recognized that increasing the number of allowed violation days could result in an incremental increase in the average. The reason for this is that in order to avoid a violation by an occasional sharp peak, our average levels must be kept quite low.

The relaxing of Federal Auto Emission Standards would have a detrimental effect on Portland's current strategies for achieving attainment. The state implementation plans prepared by DEQ rely quite heavily on improved auto emissions in achieving goals for carbon monoxide and ozone by 1987.
Therefore, changes in auto emissions standards would require other more complex strategies to be substituted in order to reach the required levels.

1. Conclusion

Relaxation of auto emission standards would have a detrimental effect on maintenance of air quality in the Portland area.

2. Recommendation

Present vehicle emission standards mandated in the Clean Air Act should be continued as scheduled.

D. Institutional Framework - Discussion

The charge to this Committee asked, "Is there currently a comprehensive, workable and coherent air pollution control policy in use as a guide for decision making in the Portland area?" Although there is no single air pollution control policy for the Portland area, there is a comprehensive policy-making process. The policy-making process for air quality in Portland operates on the federal, state and local levels. Despite the complexity of the framework, it appears that the plan represented by the implementation of standards set by the Clean Air Act, in conjunction with standards set by Oregon law, does give Portland at least a "workable" system for air quality policy decisions.

The key organization in this system is the DEQ; thus Portland is very dependent upon a state organization to assure protection of its air quality. Most witnesses before the Committee highly commended DEQ's performance. However, funding cuts at the federal and state levels have affected DEQ operations during the past year, largely in the enforcement area, according to testimony from DEQ representatives. To date both Republican and Democratic administrations at the state level have seen to it that DEQ was adequately funded. The Portland area will continue, under the current policy framework, to depend upon state allocation of funds to DEQ in order to protect its air quality.

While continued funding of DEQ and its continued responsibility for monitoring Portland's air quality according to existing federal standards appear to present a workable system, no plan now existing can be called "comprehensive" because of the inherent difficulty in satisfying competing local interests.

One unresolved problem concerns competing interests across state lines. According to DEQ, the Portland airshed received approximately 15% of its VOC emissions from Clark County. The figure represents about the same distribution of pollutants as population; auto emissions break down in a similar fashion. At this time, there is no auto inspection program operating in Clark County. There does not seem to be a local, interstate body now constituted which can deal with these emissions in a formal way. The only such body which is now constituted to deal with interstate issues in air quality is the Bi-State Policy Advisory committee, which is more a forum for discussing mutual local interests than a body empowered to make decisions about pollution control strategies.

Another area not coherently organized under the current institutional framework is the management of competing local or regional interests. The recent attempt by a regional organization, Metro, to locate a garbage burn-
er in Oregon City exemplifies the impact that local pressure can have on a project which has the approval of state and regional authorities. Citizen concerns over the potential for emissions from the proposed burner drew a large enough opposing force to vote down the burner in several ballot measures. This occurred despite the fact that DEQ was willing to grant an air quality permit to the project.

To a large extent, effective air pollution control depends on the cooperation of local constituencies, rather than on the activities of state and regional authorities. This is true because air quality is affected by seemingly unrelated decisions made by local constituencies and also because air pollution control mechanisms sometimes create other problems which must be dealt with by local jurisdictions. For example, strategies intended to reduce the congestion of automobiles in downtown streets have an effect on auto emissions. A backyard burning ban would reduce air pollution by particulates, but would require alternative solid waste disposal mechanisms in order to be effective. Such mechanisms in turn affect local sites for waste disposal, and so forth. Thus, a completely coherent and workable air pollution control policy may not be possible without reducing local control.

Given the need to foster cooperation of local interests, your Committee has viewed with considerable interest the working of the Portland Air Quality Advisory Committee, which was formed to advise the DEQ and Metro on the state implementation plans for attaining and maintaining state and federal standards for CO, ozone, and TSP. The advisory committee's official mandate ended with the adoption of the state implementation plans. However, the representative nature of the group as well as its experience in recommending control strategies and considering health, economic, social and energy impacts of those strategies over a period of years makes it a valuable resource in the Portland area. There is no other single source where representatives of business, city and local jurisdictions; the public at large; and environmental advocacy organizations meet on a regular basis with those responsible for implementing policy on air quality issues. In addition, the committee had three invited members, non-voting, from Washington state, and had as a goal the fostering of interstate coordination of policies. Another important quality which the advisory committee seems to have had in this context is the flexibility to take up new air quality issues as they arise, perhaps more flexibility than a government agency concerned with implementing existing policy would have.

1. Conclusions

a) Despite the complexity of the process of air quality decision and policy making, the results for the Portland area have been very good. The state implementation plans have broad-based approval from the various constituencies involved, and good progress toward compliance with federal standards is occurring.

b) A formal means of continuing to promote institutional cooperation and coordination between local jurisdictions for air quality protection is advisable for the Portland area. Such a means should include bi-state and public-at-large representation.

2. Recommendation

The Portland Air Quality Advisory Committee should be constituted as a permanent advisory committee to DEQ and Metro.
E. Economic Aspects of Air Quality - Discussion

The efforts undertaken in the last decade to clean up the nation's pollution have been quite costly. A report published for the EPA in 1979 estimated that the total cost for control of air and water pollution between 1977 and 1986 will be about $360 billion (in 1977 dollars). Two-thirds of this total ($229 billion) is devoted to air pollution under provisions of the Clean Air Act. Capital investments for federally funded air pollution controls will total about $81 billion during the period. The report estimated the annual cost for air pollution controls in 1977 to be $14.3 billion. Since motor vehicle emissions are a major source of pollution, efforts to reduce these emissions have been particularly earnest -- and costly. In 1977, consumer investment for vehicle pollution controls was an estimated $3 billion, nearly 4% of total consumer spending on motor vehicles and parts that year (39). Although these figures give some indication of the magnitude of the cost of cleaning up the air nationally, no such cost breakdowns are available for Oregon or Portland.

Other aspects of the economic effects of air pollution control have been studied in Oregon. Of particular importance is the impact that the costs and difficulty of pollution abatement have on growth and development of the region's economy. Standards set by EPA apply nationally and compliance with the standards does not seem to put Oregon at an economic disadvantage compared to other parts of the country. While considerable leeway is left to the states in determining specific strategies, in practice, the similarities between programs in different states outnumber the differences. In the Portland area specifically, your Committee discovered only one instance where Oregon's requirements for industry were significantly different from those in Washington. "Major" new sources of industrial emissions must conduct a rather extensive analysis of the effects of new emissions (as detailed in Section IV, B-1). An industrial source is deemed "major" if it emits above a certain level for specified pollutants. In Oregon, "major" source studies are required beginning at a level of emissions considerably lower than in Washington. One witness told your Committee that the more stringent rules for some pollutants, particularly TSP, amount to a significant competitive disadvantage to Oregon in trying to attract new industry. Other witnesses, however, stated that even the emission level specified in the Oregon rules is high enough to exempt the majority of new industrial sources. None of the witnesses interviewed had knowledge of any instance where a company had decided not to locate in Oregon because of air quality regulations.

The failure of an area to gain attainment with national ambient standards, however, does have important consequences for local economic development. No new sources of industrial emissions can locate within a non-attainment area unless they are compensated for with an emission offset or growth cushion. The effects of various strategies for managing economic growth in a non-attainment area were assessed in a 1980 study for the City of Portland (33). The study was conducted by a private consulting firm and funded with a grant from EPA. The study recommended emission offsets and a banking program for emission reductions as acceptable and feasible methods for creating room in the airshed for new industrial emissions. Under this strategy, a new source is required to provide reductions of existing emission to "offset" the new emissions to be created. This can be done by purchasing additional control equipment for existing industries, or otherwise arranging for emission reductions. An existing industry can reduce emissions more than required and "bank" the additional reduction for future use or for sale to another party. The EQC adopted these offset and banking
strategies as part of the state implementation plans. The study estimated employment growth to be 155,000 new jobs in the region between 1977 and 1987, if no additional regulatory constraints were adopted. Requiring industry to pay the costs of obtaining offsets in addition to providing other required emission controls was projected to reduce employment growth by 3%, or 4,000-5,000 jobs. (Note: These projections were developed during a period of heady growth and did not anticipate the current economic slowdown. Hence, the impacts are likely to be of lesser magnitude than indicated. The overall decline in economic activity has most likely resulted in emission levels significantly lower than projected. This is an example of how emission projections, and resulting control programs, are very dependent upon assumptions which may not turn out to be accurate, despite careful analysis and planning.)

The EQC has adopted a growth cushion strategy in the state implementation plan for ozone. Emissions throughout the region are reduced to a level beyond that needed to attain national ambient standards. This creates a "cushion" of emission reductions that can be allocated to new point sources on a first come, first served basis. DEQ projects a growth cushion of about 1% to be available for VOC emissions by 1987. Because "worst case" assumptions were used in projecting the cushion, the estimate is conservative. Actual emissions in 1987 may provide more than a 1% cushion. Meanwhile, the 1% margin (1,700 kg/day) is being parcelled out by DEQ to new sources, with approximately 700-900 kg/day already allocated. The growth cushion is split 85%-15% between the Portland and Vancouver portions of the AQMA, based on population share and contribution to total VOC emissions (16, 56, 71).

Several alternatives are available to increase the available growth cushion for VOC emissions, if needed. Two strategies appear particularly promising: a) control of fugitive gasoline vapors as fuel is pumped from service station tanks to motor vehicles; and b) changing the vehicle inspection program to require annual, rather than biennial inspections and maintenance. Table 11 lists potential additional VOC emission control strategies with their projected benefits and costs.

A key question to be answered is where to place the direct burdens for creating room in the airshed for new industrial sources: on the potential new sources, on existing industries in the region, or spread among all of the existing pollution sources in the region, both industrial and individual. DEQ has chosen to use a combination of these approaches, suiting the strategy to the particular requirements of each pollutant.

Is there parity now in controls required of industrial and individual polluters? Witnesses from a broad spectrum of viewpoints agreed that a disproportionate share of the control burden is now shouldered by industry, which has, through successful point source regulation, greatly reduced its contribution to the airshed's pollutants. The industrial sources do require continued attention to insure that existing controls are not compromised, and to assure that control requirements are applied to new stationary sources. However, it seems clear that the next stage of pollution abatement from area sources will involve individuals, far more than it has in the past ten years. Additional incremental increases in emission reductions from industrial sources would be extremely expensive, approaching the point of diminishing returns. (In the long run, the individual consumer does, in any case, pay for the cost of industrial pollution control through higher costs for goods.)
Public education will play a major role in the implementation of this shift in policy. At present there appears to be a slim budget for air quality education within the DEQ, and little earmarked elsewhere. After 18 months of study, it has become clear to the members of this Committee that the information base on air quality is exceedingly complex. As the public is asked to assume a larger role in preventing pollution, efforts at education will need to be increased.

Direct regulation of the individual polluter in Oregon has so far been limited to the biennial vehicle inspection program, some transportation strategies and some limitations on backyard burning. The easiest, cheapest and most effective strategies for achieving further reductions seem to lie with regulation of area sources, particularly auto emissions, wood stove emissions and backyard burning emissions. The main impacts of these controls will be on the individual area resident.

Two other important points were raised in your Committee's discussions of the economic impacts of air quality. First, it should be noted that even the so-called "clean" industries contribute significantly to pollution problems. For example, the motor vehicle traffic generated by large numbers of employees traveling to and from a large electronics plant, creates considerable emissions of VOC and CO. (Industries or commercial operations which attract large numbers of automobiles are required to obtain an indirect source permit from DEQ.) The electronics manufacturing process also contributes a substantial level of VOC emissions resulting from use of paints and cleaning solvents.

Second, the Portland area has achieved an image of natural attractiveness and livability. This image was mentioned by witnesses as an economic asset, because of its role in attracting new firms and new residents, and because of the region's important tourist industry. Maintaining or improving Portland's air quality is an important factor in protecting this image. Your Committee feels that aggressive efforts to comply with national ambient standards should continue to help maintain this intangible asset.

1. Conclusions

a) Air pollution control strategies in the Portland area have not placed the Portland area at an economic disadvantage relative to other areas.

b) Since it is necessary to comply with federal air quality standards, the margin for economic growth in the Portland area is potentially limited.

c) Industry has been heavily and successfully regulated, with a resultant reduction in air pollution. Further regulation necessary to meet federal standards will have a greater impact on individual polluters than in the past.

d) Additional emission reductions, if needed to allow for economic growth in the region, will come largely from controls of area sources like transportation and vegetative burning. This approach lends itself to use of a growth cushion strategy, when dependable projections of emissions reductions are available. However, offsets and emission banking are valuable options which should be used as well.
F. **Vehicle Inspection/Maintenance Program**

Oregon was one of the nation's pioneers (along with New Jersey and Nevada) when, in 1975, the state began a mandatory biennial inspection and maintenance program for autos registered in the Portland area. Many other states are now implementing similar programs as a result of amendments to the Clean Air Act which allow a five-year extension of the 1982 deadline for attainment of ambient pollution standards. Establishment of an inspection program is a prerequisite for gaining a deadline extension from the EPA. Inspection programs were to be in operation in 28 states by January, 1983, nearly all of them requiring annual vehicle inspection. The state of Washington started an annual inspection program in the Seattle area in January, 1982 (13, 66).

The biennial inspections in Portland have been effective in reducing vehicle emissions by as much as one-third. An EPA-funded study in 1980 compared emission levels of vehicles in Portland with those of vehicles in Eugene where no inspection program exists. Average vehicle CO emissions in Portland were 34% below those in Eugene, and vehicle VOC emissions were 24% lower. These emission reductions resulted in substantially lower overall concentrations of the pollutants in Portland's airshed -- 15-25% lower for CO and 25-30% lower for ozone (VOC emissions are a major contributor to ozone pollution) (36, 70, 71). The study also indicated that emission levels begin to rise again after the inspection and required maintenance. The performance level of the engine and its emission control equipment deteriorates through use and wear, causing emission levels to increase. Within one year from the vehicle inspection, VOC emissions had climbed nearly to pre-inspection levels. The increase in CO emissions was slower, but did show some increase after one year. It is estimated that a program of annual, rather than biennial inspections and maintenance would result in an additional 10% drop in ambient CO concentrations and as much as a 20% further reduction in ozone levels (36, 70, 71).

DEQ has not pursued an annual program because the biennial inspections are projected to bring Portland into attainment with ambient standards for CO and ozone prior to the 1987 deadline. An annual program, however, would further reduce auto emissions and thereby improve ambient air quality. This would create an additional growth cushion, primarily in VOC, which could be dedicated to industrial expansion, economic growth and population growth, or to allow cutbacks in other more costly emission control efforts.

A $7 certificate fee allows the existing biennial program to be self-supporting, and this is expected to hold true for an annual program as well. Though detailed cost estimates are not available, DEQ believes that an annual inspection program would require only an approximate 50% increase in the number of emission-test employees. Total cost of the annual program would be much less than twice the cost of the existing program, while twice the revenue could be collected. It is possible, therefore, that the current $7 fee could be reduced in an annual inspection cycle, or that the inspection program could become a source of revenue to support other emission control programs. (Fees for other inspection programs across the country range from $2.50 to $12.00.)

Enforcement of an annual inspection program has been viewed as a potential problem by DEQ. The current program is tied to the state's biennial auto registration, so that vehicle owners cannot renew their registration without producing a certificate of compliance with DEQ inspection. Enforcement of an annual program would have to take another form since it
would no longer coincide with the auto registration cycle. Presumably, motorists would have to display some sort of sticker on the vehicle or license plate indicating compliance with the test procedures. Enforcement of the inspection requirement could only be effective, however, if motorists perceived a risk of being cited by police for failure to display the compliance sticker. Enforcement cooperation from local police agencies, therefore, would be essential to the success of an annual inspection program.

An inspection program for the Clark County area of Washington was planned to begin in 1982, at the same time that the Seattle program took effect. Washington had contracted with a private firm to operate its inspection programs, and plans for the Clark County program had proceeded so far as to include contract specifications for the private operator. The EPA had a late change of heart, however, and decided to exempt the Vancouver area from the inspection requirement, in spite of the fact that Clark County is not in attainment with the primary ozone standard. As grounds for its ruling, EPA cited the fact that the existing inspection program in Portland is projected to bring the Portland AQMA into attainment by 1987. An inspection requirement for Vancouver, said EPA, was therefore not necessary.

About 16% of the total AQMA population lives in Clark County. Clark County is the source of 17.5% of the area's VOC emissions from autos. While no precise figures are available, it is believed that Clark County's contribution to total CO emissions also falls in the 10 to 20% range (11, 56). The fact that nearly one-sixth of the area's population is exempted from the inspection requirement raises serious questions of equity. There is also a question of whether the area is missing an opportunity for a simple, inexpensive and effective way to achieve further emission reductions, since the framework for an inspection program in Clark County is already in place. Additional emission reductions achieved in this manner could create a larger growth cushion in the airshed for industrial expansion, economic growth and population growth, or could allow cutbacks in other more costly emission control efforts.

1. Conclusions

   a) The existing biennial auto inspection program, together with other components of the present state implementation plan, appears to be sufficient to bring the area into attainment with standards.

   b) Conversion to an annual inspection program affords an opportunity for further reduction in emissions at relatively low economic and social cost, to create room in the airshed in the event that current controls fail or to accommodate additional emissions from expansion of industry in the region.

   c) The failure of EPA to require an inspection program in Clark County was both unfair and unwise. Since vehicles in Clark County contribute significantly to the area's pollution problem, they should not be exempted from an emission control effort which is mandatory in Portland and has proven benefits.
2. **Recommendations**

a) Annual emission inspections for vehicles in the Portland area should be given a high priority, if the need arises to meet standards or to permit industrial growth in the area.

b) Oregon citizens and officials should begin immediately to actively encourage adoption of an equivalent inspection program for Clark County.

G. **The Role of Fine Particulates**

Several sections of this report have pointed to the problems posed by the fine particulate component of TSP, which is more likely than its larger counterpart to affect human health and which also contributes significantly to visibility problems because the small particles have a light-scattering effect. The health effects stem from the small size of the particles. Those under 15 microns are considered inhalable, while those of less than 2 microns are considered respirable, i.e., capable of penetrating the lower respiratory tract. Under current TSP standards, all particles -- and they range in size from less than one micron to 500 microns -- are measured by weight. This tends to mask the contribution of the more dangerous fine particles. In Portland, fine particles account for about 30% of the TSP by weight, but are in fact the numerical majority. It also is important to note that although the Portland AQMA meets the primary (health) standards for TSP, it is designated as in non attainment for secondary particulate standards. Therefore, sources of pollution which contribute to TSP are of concern.

Because of the concern about health effects of respirable particles, the EPA is considering changing the particulate standard to one based on fine, not total particulates. Under the current standards, Portland's control strategies will necessarily focus on controlling soil and road dust since these are the main sources of TSP as currently measured. However, if the standard is changed to a fine particulate standard, the main concerns will shift to controlling vegetative burning and auto exhaust.

Road and soil dust plus vegetative burning far overshadow industrial sources of TSP. Dust accounts for most of the larger particles, while vegetative burning plus auto and particularly diesel exhausts are the greatest contributors to fine particulates in Portland. There is currently no inspection program to reduce particulate emissions from diesel engines. Diesel engine exhaust contains 30-100 times as much TSP as gasoline engines. Currently, the motor vehicle fleet contains only 3-5% diesel engines; despite emissions 30 times greater than other motor vehicles, there are so few diesels that they are not considered a serious problem. Estimates in 1980 indicated that diesels would grow to perhaps 15% of the motor fleet by the end of the decade. Recent trends however indicate that this projection may be too high (68). In addition to an increase in the percentage of diesels in the fleet, emissions from diesels could pose a problem. If the ambient air standard for TSP is changed to a fine particulate standard, emissions from diesels will become more important since 90% of them are respirable.

EPA has been slower to implement auto emission standards for particulates than for CO, VOC, and NO\textsubscript{x}, presumably because of the relatively lower contribution of automobile exhaust to total particulates compared to CO, VOC, and NO\textsubscript{x}. 
A particulate emission standard for automobiles of 0.6 gm/mile was implemented by the EPA for 1982 model years. This standard was relatively easy for manufacturers to meet with minor engine modifications.

A particulate standard of 0.2 gm/mile was scheduled to be implemented for 1985 model years, but may be delayed until 1987 model years. It is argued that this standard is considerably more difficult for manufacturers to meet because of the need to employ particulate trapping devices. However, delay in meeting the standard could have serious consequences for fine particulate levels in the airshed if the size of the diesel fleet increases significantly.

1. Conclusions

a) Although the TSP levels have been relatively stable in recent years, the contribution of fine particulates is increasing due to increased vegetative burning and vehicle exhaust (especially from diesel engines).

b) Fine particulates represent a potential health hazard as they are respirable. They also impair visibility.

c) A strategy of controlling road dust, while helping to meet existing standards for total suspended particulates, will have little impact on health and visibility.

d) Further regulation of vegetative burning, especially of wood stoves and backyard burning, may be necessary to comply with a fine particulate standard, if one is established.

2. Recommendations

a) A national fine particulate standard based on best scientific data should be adopted.

b) Federal diesel emissions standards for particulates should be implemented in a timely manner.

H. Backyard Burning

Open burning of yard debris contributes only about 1.5% of the overall particulate pollution in the Portland area, and a source of that magnitude would not normally be viewed as a major pollution problem. Just the same, backyard burning has been the cause of much discussion and controversy in recent years because of evidence that the impact may be much greater than indicated by the 1.5% figure.

Some of the reasons for concern expressed to your Committee:

1. Most burning takes place in residential areas where the impact on people may be more dramatic than the impact of other pollution sources.

2. The impact may be very localized. While the overall effect on the airshed may be slight, a yard debris fire may raise pollution levels over a few neighboring blocks.
3. DEQ pollution monitoring stations are located primarily in areas of high industrial emissions and heavy auto traffic, not in residential areas where they can accurately measure the effects of backyard burning.

4. The smoke from backyard burning contains particularly high concentrations of the respirable particulates that potentially create the greatest health hazards. If an ambient standard is adopted for fine particulates, emissions from backyard burning could become a factor in standard violations.

5. Smoke from backyard burning is viewed as a nuisance by many of those who do not burn, because the smoke reduces visibility, is an irritant, causes soiling and sometimes creates unpleasant odors.

The EQC withdrew its proposed ban on backyard burning in 1981 because of intense pressure from citizens, legislators and prominent local officials. About one-third of the area's residents regularly use burning as a means of disposing yard debris (62). Opponents contended that the ban would have placed citizens in an impossible situation, since no alternative methods of disposal were available. The state legislature, in fact, made availability of alternatives a prerequisite for any future ban on open burning.

However, several witnesses told your Committee that no such alternatives are likely to be developed until a burning ban is in place to act as a catalyst. In other cities where open burning has been prohibited, public agencies and private firms have created disposal systems which are simple and inexpensive. The PAQAC, in testimony supporting a burning ban, said that private debris-processing operations which have been established in the Portland area need the guaranteed high volume of material created by a ban in order to remain viable. This is supported by Metro's study of debris processing alternatives. Metro's March, 1983 report states that four private firms have established debris processing centers in the area with the capacity to turn much of the current volume of yard debris into useable fuel and mulch. "To cover costs," says Metro, the firms "must receive and process a total of 196,200 cubic yards annually" (80). This amounts to approximately 40% of the total yard debris now burned or placed in area landfills.

The processing centers have the capacity to handle nearly all the yard debris now generated, so it appears that the need for a means to dispose of debris has largely been met. The important link still missing is a system for collection of the debris. Location of dumpsters at a central collection site has been tested by local governments in several Portland neighborhoods, and in Beaverton, West Linn and Troutdale (74). While a good first step, this type of collection may impose hardships on those who do not have the means to transport debris to the collection site. A more reliable system, providing house-by-house curbside collection, seems necessary. This was successfully tested in Oregon City, Gladstone and Lake Oswego (74). Curbside collection by private haulers on regular routes was shown to be the most economical and convenient method of collecting debris. One-time pickup costs ranged from $2.50 to $8.00 per household in the Metro-sponsored tests (80). However, without an adequate incentive for public participation (such as a burning ban), garbage collectors are reluctant to initiate a separate yard debris collection service. Their ability to recover capital investment is questionable unless they know that the option of burning is eliminated.
It appears that alternative disposal methods are "reasonably available to a substantial majority" of area residents, as required by state law before a burning ban can be imposed. Methods of home debris collection, however, are not yet widely available. Through a cooperative effort by local governments in the region, a practical and inexpensive system of home collection could be developed, as evidenced by pilot projects in the cities mentioned above. If steps are taken to initiate a ban on backyard burning, a one-year adjustment period could be included to allow time for finalizing collection and disposal plans. A definite date for an end to burning would provide the needed impetus to ensure the availability of these options.

Implementation of a backyard burning ban would force a change of habit and some inconvenience on a portion of the area's residents. The ban would also eliminate a neighborhood nuisance problem, aid visibility and reduce the risk of injury to public health. It would help create a margin in the airshed which could be dedicated to industrial expansion, economic and population growth, or allow the cutback of other more costly emission control efforts.

1. Conclusions

a) Open burning smoke contributes disproportionately to fine particulate pollution, which has the greatest potential impact on health. If an ambient standard for fine particulates is adopted, open burning smoke could become a contributor to standard violations.

b) Open burning creates a significant nuisance in local neighborhoods.

c) Since backyard burning is only practiced by about one-third of the region's households, it is inequitable for the remainder of the area's population to pay the enviromental and social costs of continued burning.

d) A ban on open burning would provide the impetus for development of permanent and dependable alternative systems of collection and disposal.

2. Recommendations

The EQC immediately should move to ban open burning of yard debris in the Portland area. A reasonable period (we suggest one year) should be allowed before the ban takes effect, so alternative programs for curb-side collection and disposal of yard debris can be implemented.

I. Wood Stoves - Discussion

The "energy crisis" of the mid 1970s sent the cost of home heating by oil, gas and electricity soaring. This in turn encouraged residents of areas where firewood is available to turn to wood stoves, either as the main source of home heating or as a supplement to other heat sources. In Oregon, where outdoor recreation is a popular pursuit and firewood supplies are accessible, the growth trend in residential wood heating has been dramatic. The amount of wood burned in the Portland airshed has grown from 220,000 cords in 1970 to 400,000 cords in 1982 (67). Currently, more than half of Oregon's households use wood for some space heating. It is estimated that 3% of the state's households (30,000) will purchase a new wood stove each year (63).
This growth in wood heating has had a positive effect on the conservation of other energy sources and may have saved on home heating bills. But at the same time, wood stoves have become a serious source of air pollution, especially particulates and CO. In 1970, residential wood heating created 4,725 tons per year of particulate emissions. In 1980, that amount had grown to 8,694 tons (23% of all TSP emissions). While the number and use of fireplaces has remained fairly stable, the number of wood stoves has increased greatly. As a result, the growth of particulate emissions from wood stoves has been even more dramatic, rising from 875 tons per year in 1970 to 6,512 tons per year by 1980. Wood stove emissions are projected to grow to 11,500 tons by 1987. (By way of comparison, industrial sources of TSP in the Portland area produced 10,300 tons in 1970, with industrial emissions reduced to 3,000 tons by 1980) (49, 72). Wood stoves accounted for about 7% of the area's total CO emissions in 1980 (70).

The upward trend in wood stove pollution has been furthered by the use of more air tight stoves and the practice of dampering down flames to make wood burn longer. This has proved something of a false economy, since incomplete combustion results and some of the wood's energy value escapes up the chimney in the form of particles and gases which pollute the air.

The true impact of wood stove emissions is difficult to assess because most pollution monitoring stations have been located in areas of industrial and vehicle emissions. Most wood stove use occurs in residential areas in the late fall and winter months, when stagnant weather patterns are prevalent. Concentrations of pollutants in neighborhoods may build to even higher levels than those indicated at monitoring sites.

Perhaps the most serious aspect of the pollution problem caused by residential wood heating is the size of the smoke particles. About 80% of the particles emitted by burning wood are less than 2 microns in size. These respirable particulates create a greater potential health risk because they are small enough to avoid the body's natural filtering mechanism and can settle deep in the respiratory system. On worst days in the Medford area, more than 86% of respirable particulate derives from wood heating. In Portland, up to 75% of respirable particulate comes from wood stoves on worst days (63). The impact of small particle emissions from wood stoves may take on even more importance if a fine particulate standard is adopted by the EPA.

Wood burning in fireplaces also creates particulate and CO emissions, but fireplaces are generally considered to be less of a problem because the open fire box in a fireplace allows more complete combustion. In addition, while the use of wood stoves is growing dramatically, fireplace use is expected to remain stable or decrease slightly.

State law currently prohibits the DEQ from enacting any program to regulate the use of home heating devices, so any new program to reduce wood stove pollution would require legislative approval. A ban on use of wood stoves is not foreseen. The witnesses interviewed by your Committee agreed unanimously that this was neither proper nor necessary. Rather, the focus of pollution control efforts has been to make wood stove use both efficient and clean. Since wood stove pollution is a relatively new problem in this country and is confined to areas of the country like the Pacific Northwest and New England, there is virtually no previous experience to draw upon in creating pollution control strategies.
The DEQ has advocated a three-tiered approach to the problem in Oregon:

1) **Weatherization** — Home weatherization reduces the overall heating requirements of a home and, hence, could reduce the need for wood stove use. DEQ has adopted the policy of encouraging weatherization programs in the area. Low interest weatherization loans are available from local electric utilities and through the City of Portland. Weatherization tax credits are also available. The City of Portland has proposed a mandatory weatherization law which requires all homes to be fully weatherized before they can be sold. The law requires approval of the City's voters before it takes effect in 1984.

2) **Education** — Significant emission reductions can be achieved simply by using proper burning techniques, and DEQ has produced a number of pamphlets and radio/TV announcements to inform wood burners of the best way to use wood heat.

3) **Research** — DEQ planners believe the ultimate solution is the development of a wood stove design which burns more efficiently and cleanly. The state has secured grants from EPA to study the emission levels of various stove designs and promote development of a "clean" stove.

As a result of the research effort, DEQ asked the 1983 Legislature for authority to begin a mandatory wood stove certification program. An emission standard has been developed and has a procedure for testing stove models. The proposed program called for emission tests to be conducted in collaboration with an efficiency test sponsored by a national wood heat trade association. Cost of the test (an estimated one time cost of $1500-$2000 per model) would be borne by the manufacturers. Only stove models which are certified to have passed the emission test would be permitted to be sold in Oregon. The proposal envisioned a 1-year phase-in of the certification requirement with the mandatory program taking effect in July, 1985.

DEQ analyzed two existing stove models in developing its testing procedure and found both of them to emit particulate levels well within the proposed standard. This indicates that the technology for producing a "clean" stove is available. Although DEQ tested only two stoves in developing the certification procedure, it is estimated that at least 8-10 other stove models currently on the market would comply with the proposed emissions standard.

As old stoves are replaced by the new, "clean" models, over a 15-20 year period, wood stove particulate emissions are projected to fall to a level 75% below what they would be without the certification rule (63).

The program would be enforced with civil penalties applied to manufacturers and/or dealers if they sold or advertised uncertified stoves in Oregon. Individual stove purchasers, owners and users would not be liable.

Initially, consumers would have to pay more for clean-burning stoves. Units now on the market range from $200-$1,400, with the average price near $500. DEQ estimates that the cost of a certified model would range from $800-1,000, although one of the models tested has recently been advertised for less than $750. One representative of the wood stove industry stated that the increased cost of manufacturing the clean-burning stove may amount only to $100-150. DEQ and industry representatives agree that competition
and further development of technology will work to lower the cost of the new stoves in future years. There also initially would be fewer models from which to choose. However, a mandatory certification program should motivate stove manufacturers to produce cleaner-burning appliances. An industry representative stated that many manufacturers are already developing new stove designs which would meet the emission standard. Because cleaner-burning stoves are also more efficient stoves, stove users will be able to save an estimated $50-100 per year in wood fuel costs, helping to offset the added purchase cost within a few years. The new stoves should also enhance home safety. By burning the wood fuel more completely, these stoves will reduce creosote buildups that have become a major residential fire hazard in recent years (5, 8, 23, 63).

The proposed legislation to implement the program dedicated a portion of the projected emission reduction to industrial growth and development. DEQ estimated that just half of the emission reduction projected by the year 2000 as a result of the certification program would create room in the airshed for new or expanded industry creating 24,000 jobs (63).

The program was proposed for statewide implementation. While environmental impacts of wood heating are most pronounced in the state's major population centers, stove emissions are a major concern in other cities like Medford, Ashland, Grants Pass, Bend and Baker. The program would be difficult to enforce if it were limited to specific urban areas where the impact of stove emissions are most severe. A resident of one of these cities would need only to travel to a nearby community not included in the certification program to purchase a stove there which would cost less, but pollute more. Even with statewide implementation of the certification requirement, this poses a potentially serious problem. Stoves sold in the Vancouver area will not be subject to the law and are easily accessible for the Portland market.

The problem of non-certified stoves being purchased by Oregon customers could possibly be eliminated if the certification requirement is applied at the time of residential installation rather than at point of sale. However, this approach is seen as more expensive, difficult to enforce, and politically unacceptable.

The DEQ considered proposing a tax credit for consumers who purchase cleaner-burning stoves as an alternative to certification. This concept was rejected because of its impact on the state budget, and because it was seen by some as a reward to people who choose to heat with wood stoves despite their high pollution. A voluntary stove emission listing program was also considered, but judged to provide inadequate emission reductions. Surveys indicate that appearance and cost are the main factors influencing stove purchase, not emission performance.

The proposed certification program was endorsed by the Portland and Jackson County Air Quality Advisory Committees, by Associated Oregon Industries, and by the Oregon Environmental Council. In legislative hearings, the program proposed by DEQ was opposed by representatives of the wood stove industry concerned about the impact of increased costs and greater regulation. Opposition also surfaced from legislators representing rural areas who thought residents of these areas should not have to pay the increased costs to solve urban pollution problems. A legislative subcommittee is considering possible compromise bills which would, among other things, limit restrictions to the Portland, Eugene and Medford areas. Such a plan would aggravate the problem of non-certified stoves being available...
in areas near the cities where sale of non-certified stoves is banned. This could put retail stove dealers in the affected urban areas at a significant competitive disadvantage. Your Committee believes that statewide implementation of a stove certification program would be more effective.

1. Conclusions

   a) Your Committee concludes that a ban on wood stoves is not desirable.

   b) As wood stove use has increased during the past decade, the resulting emissions of particulates and CO have increased rapidly during the past decade and are projected to continue an upward trend.

   c) Wood stove smoke is heavily laden with fine particulates which pose a potentially greater public health risk than most other sources of particulate emissions.

   d) Users of wood stoves can reduce stove emissions greatly by using proper burning techniques.

   e) The contribution of wood stove emissions to TSP and CO violations could be alleviated partially if residents would limit the use of stoves on days when air quality and circulation are particularly bad.

   f) A cleaner-burning wood stove is technologically and economically practical. Some stove models now on the market meet the recommended emission reduction requirements.

   g) A requirement for certification of clean-burning stoves before they can be sold in the state is a practical and effective means of dealing with wood stove emission problems.

2. Recommendations

   a) The statewide wood stove certification program originally proposed by DEQ should be approved.

   b) A formal process for informing stove users when the air quality conditions are poor should be implemented. Stove users should be asked for voluntary limitations of stove use during these periods.

   c) An aggressive program to educate wood stove users about proper ways to use stoves should be continued, so as to minimize the resultant emissions.

   d) Home weatherization should be encouraged by state and local governments as a positive approach to reducing the need for use of wood stoves for home heating.
e) The DEQ should establish pollution monitoring sites in selected neighborhoods which will allow it to more fully assess the impact of vegetative burning emissions.

Respectfully submitted,

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APPENDIX A

List of Persons Interviewed

1. Bishop, Mary, Commissioner, Environmental Quality Commission
2. Brandman, Richard, Air Quality Program Manager, Metro
3. Buist, Dr. Sonja, Dept. of Medicine and Pulmonary Physiology, Oregon Health Sciences University
4. Burton, Mike, Metro Councilor, Co-chairman, Bi-State Policy Advisory Committee
5. Canady, Larry, Communications Director, Woodcutters Manufacturing, Inc.
6. Charles, John, Executive Director, Oregon Environmental Council
7. Coate, Dr. Ed, Deputy Regional Director, EPA
8. Day, Bill, Anchor Tools and Wood Stoves
9. Donaca, Tom, General Counsel, Associated Oregon Industries
10. Gillaspie, Janet, Public Involvement Coordinator, DEQ
11. Heath, Mary, Emission Inventory staff person, DEQ
12. Hough, Merlyn, Medford-Ashland AQMA Coordinator, DEQ
13. Householder, Ron, Manager, Vehicle Emission Inspection Program, DEQ
14. Hudskick, Clifford, Director of Economic Services, Port of Portland
15. Kennedy, Judith, Air Quality Planner, City of Portland, Member, PAQAC
16. Kowalczik, John, Manager, Program Planning, Air Quality Division, DEQ
17. Kurtz, Cynthia, former Air Quality Planner, City of Portland
18. Lockwood, Steve, Member, Portland Air Quality Advisory Committee
19. McCue, Margaret, Air Quality Information Representative, DEQ
21. Schaade, Dr. Charles, Multnomah County Health Officer
22. Simon, Carl, Transportation consultant
23. Tombleson, Barbara, Area Source Control Specialist, DEQ
24. Vlastelicia, John, Director, Oregon Operations Office, EPA
25. Weathersbee, Jack, Administrator, Air Quality Division, DEQ
26. Wyden, Ron, U.S. Representative, 3rd District, Oregon
27. Young, William, Director, DEQ
APPENDIX B

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44. Tombleson, Barbara, Air Quality, DEQ, 1982.
45. "Cost Effectiveness of Transportation/Air Quality Control Strategies," Technical Memorandum #37, Metro, April 1981.
53. "Health Impact of Open Air Burning in the Portland Metropolitan Area," by Dr. Charles Schade, Multnomah County inter-department memo, February 20, 1981.
77. "Wood Stoves: Energy solution or air pollution?" DEQ pamphlet.
APPENDIX C
GLOSSARY OF AIR QUALITY TERMS

AMBIENT AIR - Any unconfined portion of the atmosphere: open air.

AOMA - Air Quality Maintenance Area.

AREA SOURCE - Air pollution that extends over a large area. Field burning, home heating, and open burning are examples of area sources.

BACT - Best Available Control Technology, required by the Clean Air Act for industries in areas not in attainment with national ambient standards.

CARBON DIOXIDE (CO₂) - A colorless, odorless nonpoisonous gas normally part of ambient air, produced by fossil fuel combustion.

CARBON MONOXIDE (CO) - A colorless, odorless, poisonous gas produced by incomplete fossil fuel combustion.

CIVIL PENALTY - A penalty imposed upon any person including individuals, corporations, partnerships, public and municipal corporations, political subdivisions, the state or federal government and agencies thereof, for violations of law.

CLASS I AREA - PSD - National parks, natural wilderness areas which exceed 5000 acres in size, national memorial parks which exceed 5000 acres in size, and natural parks which exceed 600 acres in size.

CLASS II AREA - PSD - All areas of the state not designated as a Class I or which are not a non-attainment area for a criteria pollutant.

CLEAN AIR ACT - Legislation first passed by Congress in 1963 with subsequent amendments through 1977. The Act details the requirements for attaining and maintaining air quality standards.

CO - Carbon Monoxide.

CONCENTRATIONS - Used in reference to the overall level of pollution which accumulates in the atmosphere. Ambient standards are set for the concentration level of pollutants in the atmosphere.

CRITERIA POLLUTANTS - Those recognized by the EPA and for which standards have been set. Criteria pollutants designated so far are CO (carbon monoxide), CO₂ (carbon dioxide), SO₂ (sulfur dioxide), particulate, NOₓ (oxide of nitrogen), POₓ (photochemical oxidants) and lead.

DEQ - Oregon Department of Environmental Quality

EMISSIONS - Pollutants released into the air by a particular source like a factory smokestack or the area's wood stoves. Emission standards regulate the quantities of pollutants allowed to be released into the atmosphere.

EMISSION INVENTORY - A listing by source, of the amounts of air pollutants discharged daily into the atmosphere of a community. It is used to establish emission standards.

EPA - Environmental Protection Agency (Federal)
EPIDEMIOLOGICAL STUDY - A method of scientific study where large numbers of people are randomly surveyed or evaluated, often over a number of years, looking for increased incidences or trends in occurrence rates of deaths, disease, symptoms, work loss, etc.

EOC - Environmental Quality Commission (Oregon)

EXCEEDANCE - An exceedance occurs when the concentration of a particular pollutant is greater than the concentration specified in the standards for that particular pollutant. Not more than one exceedance is counted per day for each individual pollutant.

FINE PARTICULATES - Particles suspended in air which are less than 15 microns in size and therefore capable of reaching deep into the lungs when inhaled. Those under 2 microns are considered respirable.

FUGITIVE EMISSIONS - Particles generated by industrial or other activities and which escape to the atmosphere through openings such as window, vents, ill-fitting oven closures, or poorly maintained equipment, rather than through installed exhaust systems.

HYDROCARBON - Compounds containing carbon and hydrogen, such as methane. Components of fuels. Contributor to the formation of ozone.

INDIRECT SOURCE - A facility, building, structure, or installation which indirectly causes or attracts vehicular activity resulting in emissions of air contaminants, such as a shopping center.

LOWEST ACHIEVABLE EMISSION RATE (LAER) - The most stringent emission limitation and the lowest emission rate which is achievable in practice for any such type of source, without regard to economic factors.

METRO - Metropolitan Service District

MOBILE SOURCE - A moving producer of air pollution, mainly forms of transportation - cars, motorcycles, planes.

MODEL/MODELING - A mathematical or physical representation of an observable situation. In air pollution control, models afford the ability to predict pollutant distribution or dispersion from identified sources for specified weather conditions.

NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS) - Legal limits on the level of atmospheric contamination necessary to protect against adverse effects on public health and welfare. Primary standards are those related to health effects. Secondary standards are related to property damage, aesthetics and visibility.

NITRIC OXIDE (NO) - A gas formed under high temperature and pressure, as in an internal combustion engine. Contributes to photochemical smog.

NITROGEN DIOXIDE (NO₂) - Emitted from sources or resulting from nitric oxide combining with oxygen in the atmosphere; a major component of photochemical smog.

NOₓ - Oxides of nitrogen.
NON-ATTAINMENT AREA - An area which has not met ambient air quality standards.

OFFSET - The Clean Air Act provides that a major new or expanding source located in a nonattainment area must first acquire sufficient emission reduction from other sources in the area so that air quality will be marginally improved when the new source locates in the airshed.

OXIDANT - A substance that causes the joining of oxygen to another element (oxidation) to produce a new substance (oxide). Oxidants are primary components of photochemical smog.

OZONE (O₃) - A pungent, colorless, toxic gas that contributes to photochemical smog.

PARTICULATES - Fine liquid or solid particles such as dust, smoke, mist, fumes, or smog, found in the air or emissions.

PHOTOCHEMICAL OXIDANTS - Air pollutants formed by the action of sunlight on oxides of nitrogen and hydrocarbons.

POINT SOURCE - Same as stationary source.

PRIMARY STANDARD - National ambient air quality standard set at level intended to protect public health.

PSD - PREVENTION OF SIGNIFICANT DETERIORATION - The Clean Air Act Amendment of 1977 included comprehensive new requirements for the prevention of significant deterioration (PSD) in areas with air quality cleaner than minimum national standards.

RESPIRABLE PARTICULATES - See Fine Particulates.

SECONDARY STANDARD - National ambient air quality standard set at level intended to protect public welfare.

SIP - State Implementation Plan

SMOG - Generic term usually referring to visible air pollution.

STATE IMPLEMENTATION PLAN (SIP) - A document prepared by each state, as required by the Clean Air Act, describing existing air quality conditions and setting forth a program to attain and to maintain National Ambient Air Quality Standards and prevent significant deterioration of air quality.

STATIONARY SOURCE - A source of emissions fixed in one location rather than moving. One point of pollution rather than widespread. Also called point source.

SULFUR DIOXIDE (SO₂) - A heavy, pungent, colorless gas formed primarily by the combustion of fossil fuels, a cause of acid rain.

SWAPCA - Southwest (Washington) Air Pollution Control Authority

TOTAL SUSPENDED PARTICULATE - All of the particles suspended in the atmosphere, measured by weight.

TSP - Total Suspended Particulate.
**VEGETATIVE BURNING** - Open burning of wood, leaves, or other vegetation. Primarily wood stoves and fireplaces, backyard burning, slash and field burning.

**VOLATILE ORGANIC COMPOUND** - Hydrocarbons which evaporate quickly at room temperature. Sources include bulk gasoline terminals, dry cleaners, particle board manufacturers, plywood manufacturers and firms which paint box-cars, cars, trucks, among others.

**VOC** - Volatile Organic Compound.