A SEMINAR

THE ECONOMIC IMPLICATIONS OF ENVIRONMENTAL PROTECTION

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CONSUMER IMPLICATIONS SESSION

- STATIONARY EMISSIONS -

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The Economic Implications of Environmental Protection

- Stationary Emissions -

Introduction

As the name implies, Stationary Emissions include all those sources of air contaminants, which are not generally associated with mobile sources. This includes the backyard barbecue, cigarette, pipe and cigar smokers, home fireplaces, rug beaters and mop shakers, as well as those which more readily come to mind, such as your "hydro" thermal electric generating plants, steel blast furnaces, incinerating plants for garbage and waste disposal, and all the furnaces, boilers and stoves which we use to heat space or water or cook food.

The multiplicity of sources and their infinite variety makes the problem of discussing them in any degree of depth virtually impossible in the liminted time at our disposal.

In his presentation earlier Mr. Clare indicated the relative contribution of major sources of pollution to the air contaminant burden in the USA. Just to refresh your memory we would like to show his vugraph again.

Throughout our discussions we have been using the US Department of Health Education and Welfare data to put the contribution from various sources in broad perspective. This has been done - as Mr. Clare has already pointed out - since it appears to be the best data available for reference purposes until such time as similar data is available for Canada. For automotive emissions it is considered to apply directionally to Canada reasonably well, however, we would caution that it is probably less applicable even in relative terms to emissions from stationary sources, but can at least be used to highlight the problem areas.

Major Stationary Sources of Emissions

VuGraph 1

You will note that, at 21.4%, the column under power generation and heating is next to Motor Vehicles in terms of total contribution to air pollution. You will further note that this classification is a major source of three air contaminants, sulphur oxides, nitrogen oxides and particulates.

This classification includes emissions from thermal generating plants, general industrial uses for heating as distinct from processing and residential and commercial heating. These sources represent the chief consumers of fossil fuels for combustion purposes and as such are of principal interest to the petroleum industry.

In order to simplify my presentation and keep it within reasonable bounds I shall essentially be dealing with end uses included in this category and the three major air contaminants involved. I will not be dealing with other forms of pollution from stationary sources such as the potential thermal pollution from nuclear plants or from processing industries such as steel mills, pulp mills, etc.

The contribution by each end use included in the overall category is indicated in this next vugraph for the USA.

VuGraph 2

You will note that thermal electric plants are the largest contributors to total emissions by a large margin and are the largest contributors to sulphur oxides and particulates. Industrial heating is next at about half the total of Thermal Generating plants but is slightly higher in nitrogen oxide contribution. Residential and commercial heating is substantially lower than the other two sources in total and for the individual contaminants mentioned.

VuGraph 3

In an effort to provide a comparison of the effect of various fuels on emissions an estimate of the emissions from each type per million BTU's is shown in this vugraph. Approximately 5 1/2 to 6 gallons of fuel oil represents 1 MM BTU's.

On this basis it will be seen that emissions decrease

progressively as we go from coal to heavy fuel oils to distillates to gas. These data are based on fuels representative of those supplied to the market over the past several years.

Coal is the worst offender contributing about 25% more nitrogen and sulphur oxides and about 15 times as much particulate matter as heavy fuel oil.

Distillate fuel in turn is lower in nitrogen oxides - 50% less than coal and 30% less than heavy fuel oil - and is very much lower than the other two fuels in contribution to sulphur oxides. (80% to 60% respectively) .

The only significant contribution from gas is in nitrogen oxides.

Particulates from either fuel oil type or from gas are not considered of concern.

Regulations - Current Status and Future Outlook

I would now like to turn to a review of the current status and future outlook for emission regulations governing stationary emissions.

The situation varies widely across Canada but as the Ontario Government is the most advanced in their approach to the problem and will probably provide a pattern for other Provinces to follow, I would like to use their regulations for illustrative purposes.

VuGraph 4

The concentration of air contaminants which are defined to constitute pollution by the Ontario Government are indicated in this vugraph. Limites are expressed in terms of the concentration of the contaminants in the smoke stack plume at the point where it impinges on the ground or on its closest neighbour.

To bring these regulation values into more familiar terms which we can relate to our surroundings, I have made the following estimates:

- If enough of the invisible gases called nitrogen oxides to fill a coffee cup was dispersed into this room, the regulation concentration would just be met. This amount can neither be seen or smelled. By way of further illustration cigarette smoke is estimated to contain 250 PPM of nitrogen oxides.
- As you know, sulphur dioxide is also an invisible gas, but does have a sharp odor and an acid taste. The regulation limit of 0.3 PPM of sulphur dioxide is below the odor threshhold which means that the concentration is so small, the gas cannot be detected by smell, When you smell sulphur dioxide when you strike a match, the regulation limit is exceeded.
- Suspended particulate matter is very fine dust, smoke and other solids so small in size that they float in air. Normal dust is large in comparison and settles rapidly. If we dispense smoke or other fine particulates equal in weight to that of a small paper clip into this room, the maximum limit would be met. I am sure you will all recall being in situations when smoke far exceeded this concentration.

Because of the number and variety of sources in highly concentrated areas such as metropolitan centers, regulations based on impingement are almost impossible to administer. To deal with this problem regulations concerning the level of sulphur content in fuels have been introduced covering two jurisdictions - the Toronto Metropolitan area and the Montreal Urban Community.

VuGraph 5

The limits in force and proposed for the future covering these two areas are shown in this vugraph.

Type 2 fuels - the kind used for domestic heating - have generally ranged from 0.3 to 0.75% sulphur content. You will note that in the future such fuels in Toronto will be required to meet a 0.5% sulphur limit and in Montreal a 0.4% limit in 1972.

Type 4, 5, and 6 are usually higher viscosity or "heavy" type fuels used for commercial, industrial or thermal power generation. Type 6 is the predominant one and you will note that it will be required to meet progressively lower limits in both centers down to 1.5% by 1972/73. Normally such fuels are in the 2.0 to 3.0% sulphur range.

In later years even lower limits may be called for depending on future air quality measurements. Levels down to 0.2% on type 2 fuels and 1.0 or even 0.5% on the heavier fuels may be required.

Alternative Solutions

What alternative solutions are available to the consumer or operator of a stationary source of emissions to minimize the discharge of contaminants from his particular installation?

VuGraph 6

To answer this question we have endeavoured to list a number of possible alternative in this next vugraph.

From what has already been said the first two alternatives are obvious.

The operator can select a more desirable fuel or in the case of coal and oil can endeavour to purchase a fuel of better quality.

Operators of larger installations such as thermal generating plants and industrial heating or steam raising plants may, or more probably, will have to go to the installation of sophisticated and expensive control equipment and the adoption of advanced operating techniques such as those listed to meet emission targets.

Technically all of the alternatives shown or combinations of them are feasible, not all are practical for some installations, and for others, if not all, the economics involved will be the deciding factor. Availability of fuel supply and transportation costs to the point of consumption are of course a major consideration in the decision.

We shall be touching on the added costs involved in meeting the future implication for petroleum fuels quality but are unable to present any general figures representative of the level of investments and operating costs relative to the increased hardware that will probably be required at the point of consumption. We only know that they will be substantial.

Implications for Liquid Fuels Quality

The major implications for petroleum fuel quality is inherent in the reduction of sulphur content in both distillate and heavy fuels. Recent information indicates that to assist in controlling nitrogen oxide emissions it may be desirable to control or reduce the nitrogen content of the fuel. This aspect is under investigation but as yet has not been evaluated.

In his paper Mr. Sande will be dealing with the added refining investments and operating costs associated with the reduction in sulphur content of petroleum fuels.

In the meantime, it is sufficient to say that the added costs to lower the sulphur content of distillate fuels will be in the order of twenty to thirty cents per barrel. For heavy fuels the added costs will be in the range of 60¢ to $1.00 per barrel.

Future energy demand forecasts indicate that utilization of all types of primary energy resources will be necessary to meet our needs and, that to meet air quality objectives more efficiently and effectively, will require the wise selection of fuels for specific applications and the utilization of the best technology available to permit the utilization of less desirable fuels for other applications.

In general it would seem that gas should be reserved for the more critical applications, the Hearn Plant here in Toronto is an example, distillate fuel oils should be directed towards residential and commercial heating purposes with coal and residual fuels directed towards the larger installations for power generation and industrial applications in less critical centers of population or industrialization. The specific choice of fuel and fuel quality versus mechanical control of emissions or combinations thereof will be a function of the cost of fuel quality and the cost of such control equipment.

Summary

The major aspects of this presentation are summarized in my last Vugraph.

Vugraph 7

1. The major sources of stationary emissions from combustion sources are as depicted in rapidly descending order of magnitude.

2. The principal contaminants are nitrogen oxides, sulphur oxides and particulates. The latter are readily controlled with current equipment and known operating techniques.

3. Current and proposed future regulations will require close control of the operation of the emitting source.

4. Solutions for specific installations will involve the selection of appropriate fuels and fuel quality, the addition of sophisticated control equipment and the use of advanced operating techniques for critical installations in the power generation and industrial fields.

5. The implications for petroleum fuel quality are lower sulphur contents in both distillate and heavy fuels with attendant higher costs to the consumer.