

to discourage its employment. New American refineries avoid the problem by producing no residual fuel oil; they produce instead liquid and gaseous products in the almost-sulfur-free category, and a high-sulfur-content solid residue, petroleum coke. However, since this option is not attractive to refiners in countries which lack our demand for gasoline and light fuel oil, and which export high-sulfur residual fuel oil to the United States, and since older domestic refineries still produce this product, there is still need for research to develop lower-cost methods of desulfurizing heavy fuel oil.

A start has been made with respect to this problem. Under a contract, the Bechtel Corporation investigated the cost of reducing the sulfur content of certain residual fuel oils to one percent. The most important conclusion from this study was that the manufacture of low-sulfur residual fuel oil from high-sulfur crudes requires an incentive pricing of 40 to 65 cents per barrel above fuel oil produced without sulfur restriction. This cost is increased about 20 percent if applied to an existing refinery. Further alternatives in the refining operation are being explored to lower, as cheaply as possible, the sulfur content of residual oil to 0.5 percent.

The technology of the removal of sulfur from coal is not well developed. It is known that coal-washing processes which lower the ash content of coal also lower its sulfur content to the extent that sulfur is associated with relatively large pieces of ash-substance. However, the bulk of the sulfur is more intimately associated with the coal substance and is released only by grinding and extraction processes which are presently relatively expensive. Research is needed both to lower the cost of these processes and to seek new ones. For years the needs for low-sulfur-content coal have been met from naturally occurring low-sulfur-content seams. Incentives for the development of coal desulfurization processes are of recent origin, too recent for a significant research effort to have developed.

However, studies of the forms and of the washability of sulfur in coal used in powerplants have been undertaken, and analyses of the ability of various commercial processes to remove sulfur from powerplant coals are being made. Preliminary studies of new processes for removing sulfur from coal have been made; they include air elutriation, thermomagnetic or electrostatic forces, and corona discharge.

Important as it is, Mr. Chairman, for us to vigorously pursue research and development of methods to remove sulfur from fuels and from combustion products, we must bear in mind that there are other measures which can be taken now to alleviate the sulfur oxides problem. These measures involve increased use of fuels whose sulfur content is naturally low, or locating large fuel-burning installations, such as electric powerplants, at considerable distance from large cities, and using tall chimneys.

There is no doubt that low-sulfur fuels are available in this country, but it has been only recently that government and industry have begun to examine the extent to which such fuels might be channeled to urban areas where sulfur oxide pollution has already reached serious proportions.

The construction of very large electric generating stations adjacent to coal mines is being stimulated by both economic considerations and air pollution factors. Unquestionably, construction of mine-mouth plants with very tall stacks in relatively sparsely populated areas helps to prevent the worsening of sulfur oxide pollution that would have resulted from their construction in urban areas. However, the very large size of mine-mouth plants, from which significant pollution may extend out 25 miles or more causes concern because of the possibilities of exposure of small communities and of causing extensive damage to vegetation. For such large installations, with stacks 800 to 1,000 feet high, technical estimates of ground-level pollution concentrations are subject to some uncertainty. Consequently, it is our present opinion that such plants should be limited to about 2,000 megawatts (when burning coal of about 2.5 percent sulfur) until actual measurements can be made to assess the validity of such estimates.

The increased availability of natural gas—which is essentially sulfur-free—offers still another opportunity for reducing air pollution arising from the combustion of high-sulfur fuels. The use of natural gas for domestic heating is already making a significant contribution to control of air pollution. Its increased use in electric powerplants in places with serious pollution problems could result in significant reductions in sulfur oxide pollution and in the seri-