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TITLE ECONOMICS OF SELECTED ENERGY APPLICATIONS OF PEAT IN PANAMA AND COSTA RICA

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ECONOMICS OF SELECTED ENERGY APPLICATIONS OF PEAT IN PANAMA AND COSTA RICA

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ABSTRACT

Studies were performed to determine the economic competitiveness of peat in Costa Rica and Panama. The cases examined were (1) electrical production in Panama, and (2) industrial boilers and cement plants in Costa Rica. Based on estimates of peat mining costs and the end-use costs we calculated for each application, the price of coal and oil at which the levelized life cycle cost of energy using peat was the same as that when coal or oil was used. We found that a peat-fueled power plant in Panama would be economic if the price of fuel oil was above \$0.10 per liter and the cost of

coal was above $40.00 per metric ton delivered. In Costa Rica, peat was competitive with fuel oil for large boilers (34,000 kg of steam per hour) when the cost of oil was above $0.10 per liter. For smaller boilers (5,000 kg of steam per hour) peat was cheaper than fuel oil when oil was above $0.08 per liter. Peat would be competitive in a cement plant when fuel oil prices were above $0.075 per liter.

I. INTRODUCTION

Since 1986, Los Alamos National Laboratory has been involved in a project, funded by the Agency for International Development (AID), to provide technical assistance on energy matters to Central American countries. One portion of this project was to identify peat resources and examine their possible uses. The identification of the peat resources was led by Arthur D. Cohen, University of South Carolina, and is reported elsewhere in this volume. This paper will report on the examination of the economics of using peat in selected applications: a 30-MW power plant in Panama, two sizes of boilers in Costa Rica, and a substitute for oil in cement plants in Costa Rica.

The method used to compare the costs of the different technologies was to calculate the levelized cost for each application. The levelized cost is the price charged for the output of the facility (i.e., electricity and steam) that would cause the total revenues over the lifetime of the facility to equal the total charges for the facility including capital, interest, return on investment, operating costs, and maintenance. To find the break-even costs, the levelized cost for the conventional facility was calculated without the fuel cost. The fuel price that would make the levelized cost of the peat-run facility equal to that of a conventional facility was calculated. This fuel cost is the break-even cost of fuel for the application or it is the fuel price where the costs of the conventional facility and that of the peat-fueled facility are the same. The assumption is that the real cost of the fuel is constant over the lifetime of the plant. Examining the economics in this manner removes assumptions about the future prices of coal or oil from the analysis.

The costs of using peat in the selected applications were compared with the costs of using conventional fuels: coal and oil for the power plant, oil for the boilers, and oil for the cement plant. A break-even cost was calculated for the prices of the conventional commodities as described above.

As of 1986 about 6,000 megawatts of peat-fueled electrical capacity were on line worldwide; peat was being used as a boiler fuel for community space heating and for other applications in Finland, Ireland, Sweden, and the Soviet Union. Hence, the technology for burning peat is well developed. However most of the experience in mining peat has been in northern Europe and Canada. Thus uncertainties exist as to the cost of mining peat in the tropics where weather and drying conditions are considerably different from those in northern latitudes. Estimates of the mining costs were made for the applications examined here, but because of the uncertainty of these costs, the break-even costs will be presented as a function of the mining costs.

II. PEAT APPLICATIONS FOR ELECTRICAL PRODUCTION IN PANAMA

The application considered for the Changuinola peat area in Panama was a 30-MW electric power plant located next to the peat area. Two mining methods were examined: milled peat and wet-mined peat. Also two boiler types were examined: a conventional suspension boiler and a fluidized-bed boiler.

Mining Methods

Milled peat is the most common peat mining method used today to produce fuel peat. In this method the peat bog is drained and leveled. The top few centimeters of peat are then removed by grinding the surface. This process produces peat of the consistency of sawdust. The peat is allowed to dry, which will take 1 to 2 days, and then raked into rows. The dried peat is picked up later and carried to large storage piles. Peat from these piles is subsequently trucked to the power plant. Milled peat can be used in both suspension-fired and fluidized-bed boilers with no further drying.

Wet mining is a method that has been examined for mining the peat areas in Jamaica. The first step in wet mining peat is to remove the peat using a clamshell dredge. The peat is ground into a slurry and pumped in a pipeline to the power plant where it is put through presses similar to those used in paper manufacturing. This step reduces the water content of the peat to approximately 70%. It must be dried further, using flue gases and steam from the boilers, before being sent either to a suspension boiler where the water content must not exceed 45% or to a fluidized-bed boiler where the water content is expected to be about 55%.

Boiler Types

The first boiler type is a suspension boiler, the most common boiler type used for coal. In a suspension boiler, the peat is ground to a fine dust and blown into the boiler where it is ignited.

The second boiler type is a fluidized-bed boiler. Because of its versatility and ease of pollution control, this type of boiler is being installed to utilize lower grade fuels such as coal and wood wastes. In a fluidized-bed boiler, air is blown upward in a bed of fine-grained material such as sand. The upward flowing causes the bed to "fluidize" or act as a viscous fluid. The peat is added to the the bed, and as it works its way through the bed, it is burned. The fluidized-bed boiler product has the advantages that it can be used as milled peat or it can be used directly from the dryers without further grinding. Also the fluidized-bed boiler can burn higher moisture peat.

Cost Calculations and Results

In the economic calculations, a plant lifetime of 30 years for both the conventional and the peat-fueled systems was assumed. A real (actual minus inflation) interest rate of 6% was used in the calculations of the levelized cost. The plant was assumed to be a government-owned operation so that there were no taxes and no return on investment. The plant was assumed to be financed by bonds.

The fuel break-even costs for a coal-fired electrical plant and an oil-fired electrical plant are given in Figures 1 and 2. The break-even costs are plotted against the mining costs. The best base-case values (milled peat in a suspension boiler) for the break-even costs were $35 per metric ton for coal and $0.09 per liter for oil. The present day prices shown on the graphs are estimates of the cost of imported Colombian coal delivered to the electrical facility and of the price for Bunker C fob New York.

III. PEAT APPLICATIONS IN COSTA RICA

In Costa Rica, the applications considered for peat were for use as a fuel in boilers and for use as a partial substitute for oil in a cement plant. The peat was assumed to come from the El Cairo peat area and the boilers and cement plant were assumed to be located in the central valley region of Costa Rica. Transportation costs for the peat from El Cairo to the central valley are included in the cost estimates.

Sod Peat Process

In addition to the two mining methods examined above for the Changuinola peat deposit, the cost of producing sod peat was examined for the applications in Costa Rica. Sod peat is produced by first draining and leveling the bog as in milled peat production. Then the peat is cut from the bog, masticated, and extruded in the form of cylinders. These cylinders have the consistency of clay and are left on the fields to dry. Two to three weeks are typically required for the sods to dry sufficiently for transport. However, after a day or so the sods will produce a waxy layer on their surfaces that will repel water, so the sods will not rewet if rain occurs while they are drying on the fields. Sod peat has been the favored peat form for the present tests done in the mining of tropical peat. It is also the easiest form of peat to transport.

Boiler Types

Two sizes of boilers were considered for Costa Rica: a larger boiler producing 34,000 kilograms of steam per hour and a smaller boiler producing 5,000 kilograms per hour. The cost of the larger boiler was based on boilers designed for the U.S. and included automatic controls and pollution control. The smaller boilers were based on designs for wood-burning boilers and did not include as may automatic controls and pollution control devices. Thus the relative capital cost of the larger boilers was greater than for the smaller boilers. Because the differential costs between a peat boiler and an oil boiler is large, the initial capital cost of the boiler has a significant effect on the competitiveness of the peat-fueled system. This competitiveness is reflected in the break-even costs which show that peat use in the smaller boilers will compete with a lower oil price than would peat use in the larger boilers.

Cost Calculations and Results

Figure 3 shows the break-even costs for oil for the larger boilers. Again the break-even costs were plotted against the mining costs because the mining costs are uncertain. The costs for three different mining methods are shown in Figure 3. The base-case break-even cost for oil is $0.10 per liter. The peat mining operation assumes that the peat is being mined exclusively for this boiler. Mining of peat for additional applications would probably lower the cost of peat for this application.

Figure 4 shows the break-even costs for oil for the smaller boilers plotted against the peat mining costs. As was mentioned above, the small peat-fired boilers are more competitive because they are not as sophisticated a unit as are the large boilers. The base-case break-even cost for oil is $0.08 per liter. The mining costs presented here assume that the peat mining operation is larger than is needed for one boiler: mining costs for one small boiler only would be considerably higher.

Peat can be a partial substitute for oil in cement production. Depending on the design of the cement kiln, peat can substitute for 10 to 60% of the oil usage in the plant. This study assumed that 50,000 metric tons of peat were provided to the cement plant per year and that it replaced an equivalent energy value of oil. Costs of providing special fuel handling equipment for a drying facility for the peat were included in the cost estimates. Figure 5 gives the break-even costs for oil and peat in a cement plant. The base-case break-even cost was $0.075 per liter of oil.

SUMMARY

These cost studies have shown that peat can be competitive with oil and coal in energy applications. Peat represents a domestic source of energy, and if it were used, it could reduce oil imports. The major obstacle facing peat use is the initial cost of developing the peat area for mining and the cost of demonstrating that peat can work. Mining studies and tests need to be done to determine the most economical method to produce peat for energy. However these studies will be expensive and time consuming. Costa Rica's approach of establishing peat mining by first using the peat in horticultural applications where it has a higher value than for energy uses may help to overcome the initial cost obstacle and provide the impetus to examine the possibility of using peat in energy applications.

FIGURE CAPTIONS

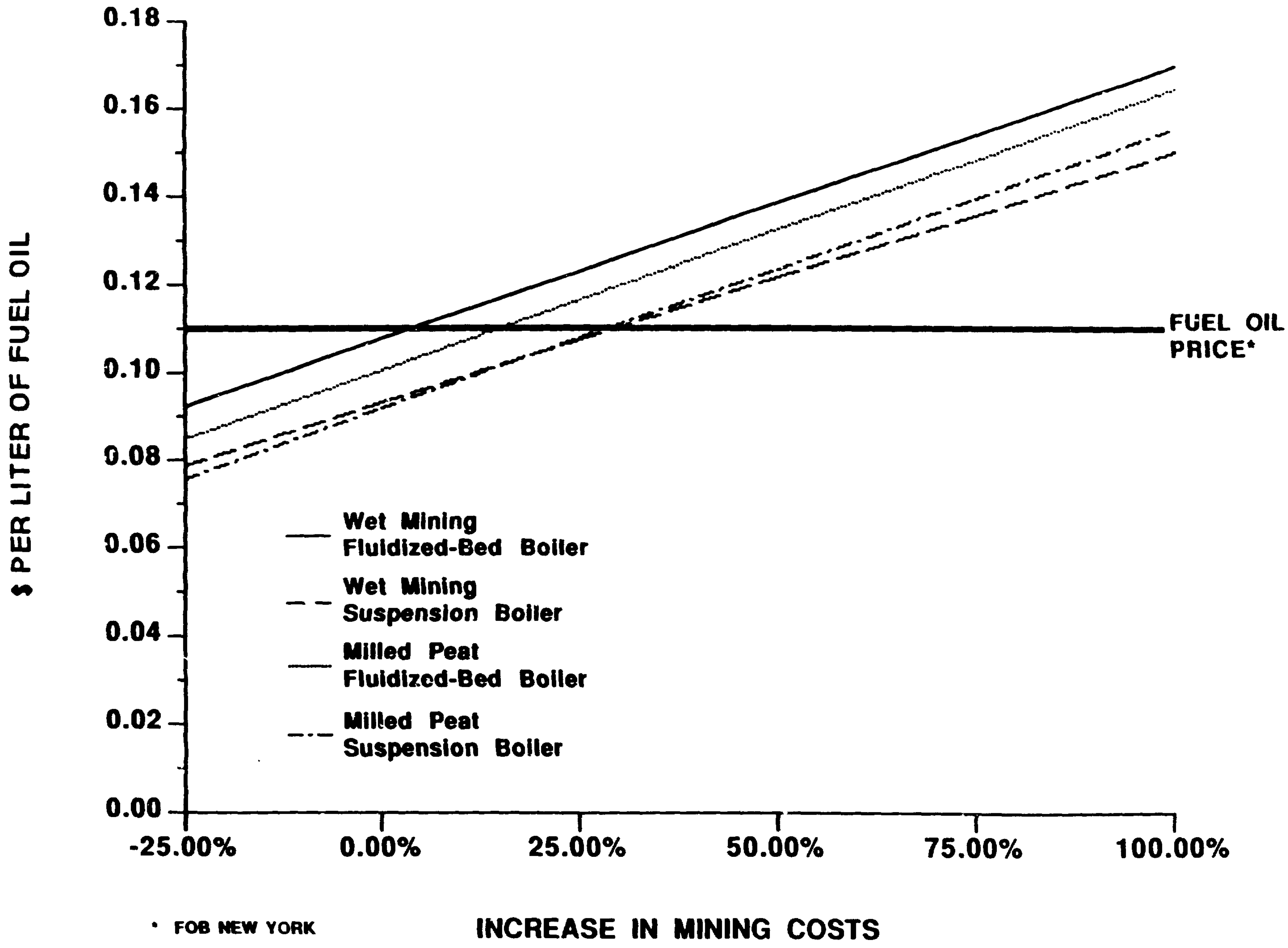
Figure 1. Break-even Oil Cost for Peat Fueled 30 MW Electrical Power Plant

Figure 2. Break-even Coal Cost for Peat Fueled 30 MW Electric Power Plant

Figure 3. Break-even Oil Cost for a Peat Fueled 34,000 kg-of-Steam-per-Hour Boiler

Figure 4. Break-even Oil Cost for a Peat Fueled 5000 kg-of-Steam-per-Hour Boiler

Figure 5. Break-even Oil Cost for Peat Use in a Cement Plant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Wet Mining Suspension Boiler
Milled Peat Fluidized-Bed Boiler
Milled Peat Suspension Boiler
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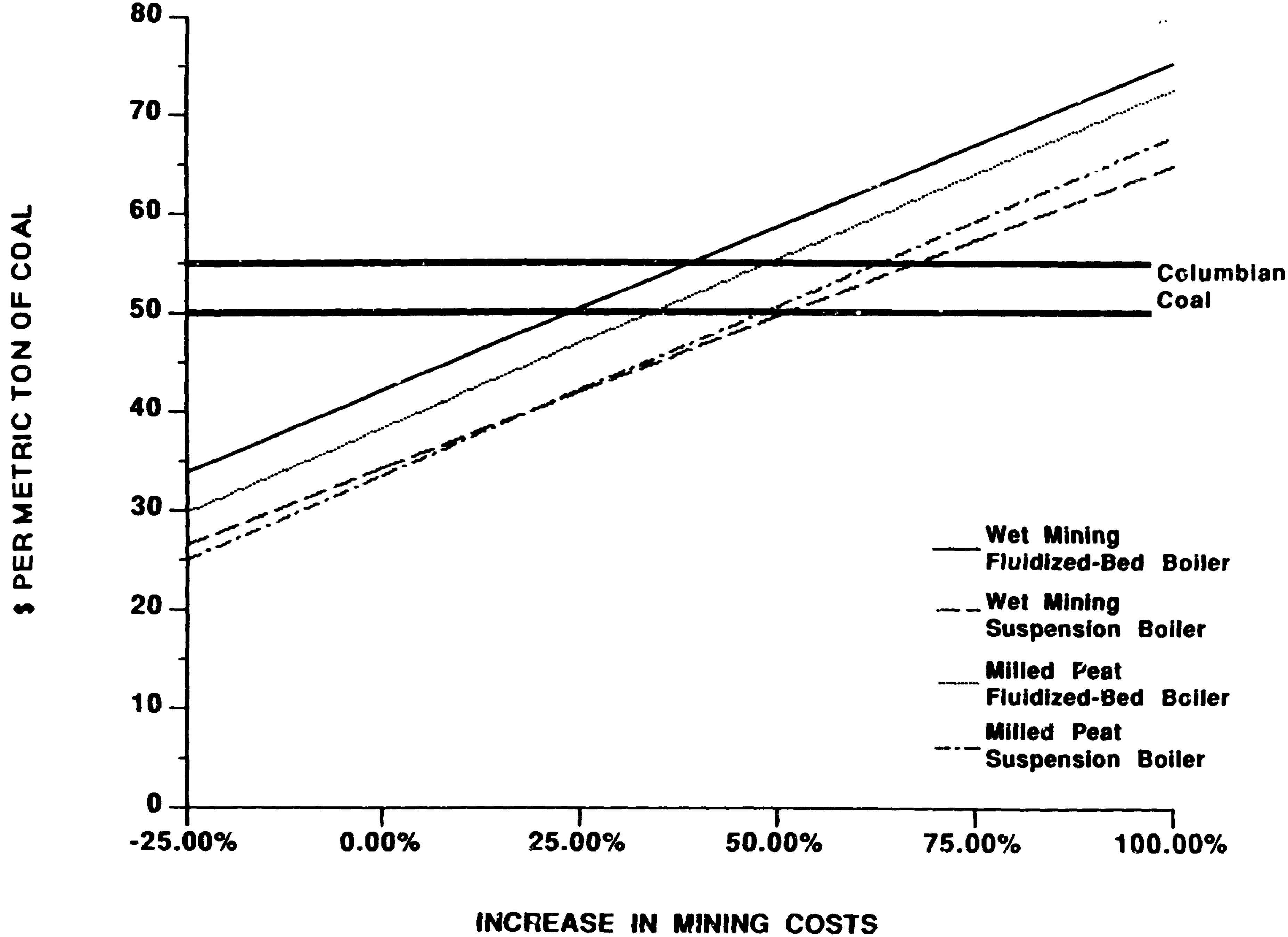
75.00%
100.00%
INCREASE IN MINING COSTS

* FOB NEW YORK



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INCREASE IN MINING COSTS
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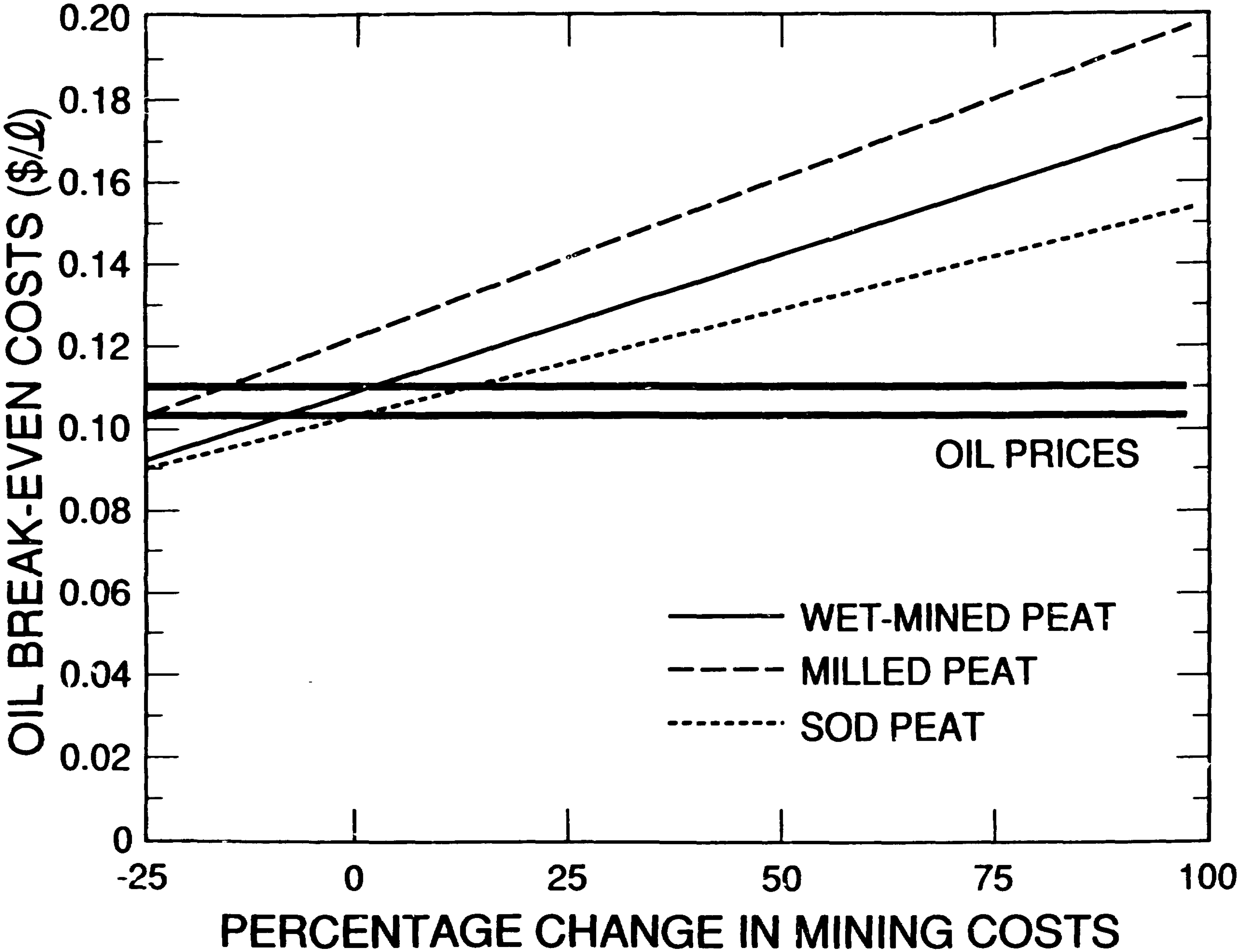
Wet Mining Suspension Boiler
Milled Peat Fluidized-Bed Boiler
Milled Peat Suspension Boiler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OIL BREAK-EVEN COSTS ($/ℓ)
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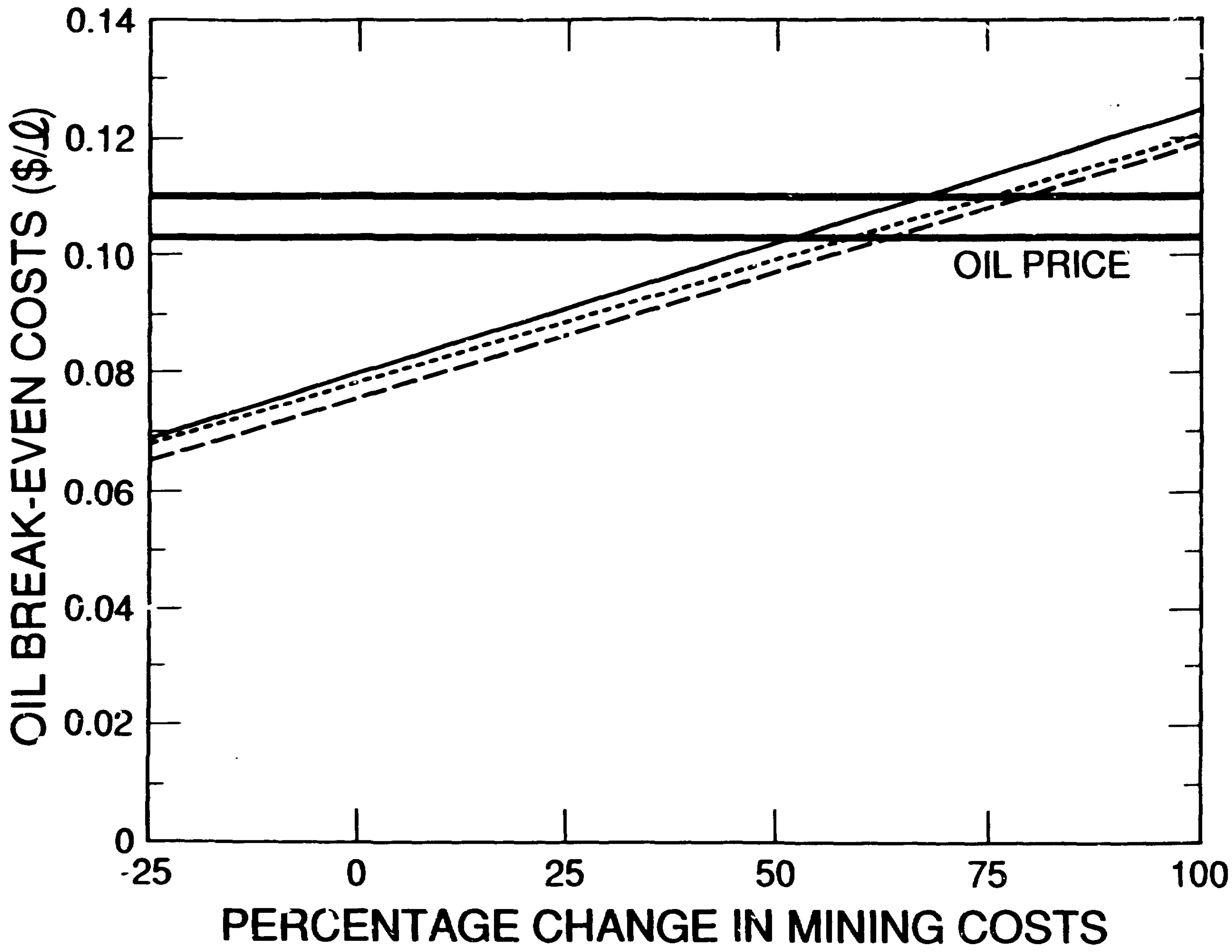
PERCENTAGE CHANGE IN MINING COSTS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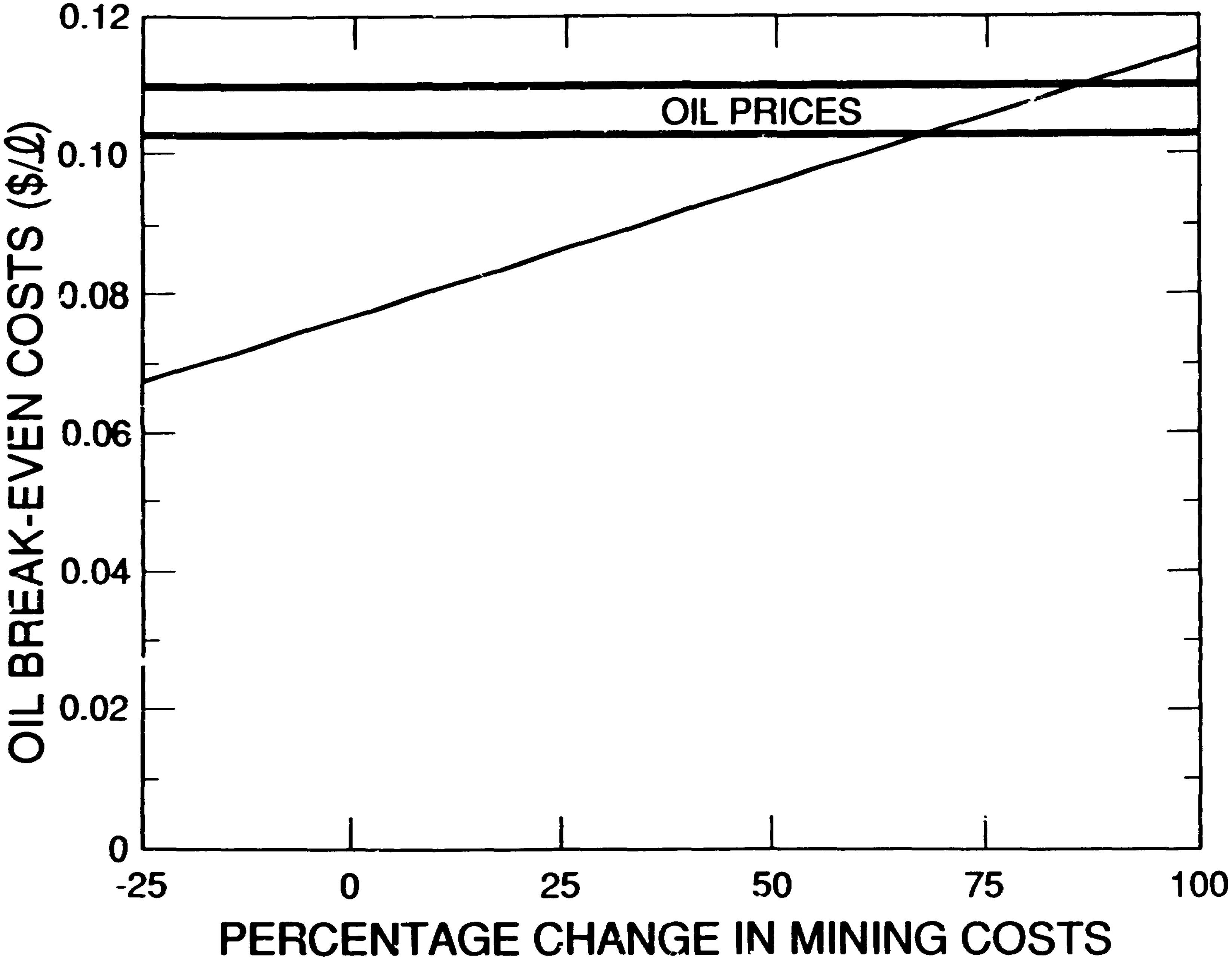
PERCENTAGE CHANGE IN MINING COSTS



OIL PRICES
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PERCENTAGE CHANGE IN MINING COSTS