UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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SUBJECT: Staff Paper on Displacing Oil Powerplants with Coal

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TO: All Those Interested

Attached is our office's economic analysis of displacing electric utility oil use with coal; we hope this paper will prove useful to you.

The analysis looks at the plant level costs of generating electricity, comparing the costs of using oil in existing plants, on the one hand, with the costs of using coal in new or converted plants, on the other. The essential conclusion is that coal, including the costs of necessary pollution controls, is generally cheaper.

In the case of conversions, this conclusion holds for a range of conversion costs, for both baseload and intermediate operation, and with and without the installation of scrubbers for pollutant removal.

New coal plants will be cheaper than existing oil plants in most oil-reliant regions of the country by 1990, the President's target date for a 50% reduction in electric utility oil use. We expect the rising cost of oil to outweigh the capital costs of constructing new coal facilities (recent oil price increases already make the oil cost used in our study look quite conservative).

The United States relies heavily on expensive imported oil. Electric utilities can displace a substantial portion of this oil by turning to domestically produced coal, while complying with applicable environmental standards and realizing substantial economic benefits for consumers.

Attachments

DISPLACING OIL POWERPLANTS WITH COAL: AN ECONOMIC ANALYSIS

EPA analysis indicates that utilities can convert many oil-fired powerplants to coal - or even replace existing oil plants with new coal plants - and reap savings for their customers while complying with applicable environmental standards. The price of oil is so high, and increasing so rapidly, that it outweighs the capital costs of converting plants or building new plants, including necessary pollution controls. We can generate electricity more cheaply with clean coal than with oil.

The comparison between coal and oil is complex, varying with factors such as type of coal and its sulfur content, region of the country, and the capacity factor at which a plant operates. The following tables present a plant-level analysis of representative cases. This analysis is conservative, in the sense that it allows for projected increases in the cost of coal over the life of a plant, but only considers oil costs at a point in time. Since oil costs will probably continue to increase, the analysis understates the economic benefits from switching to coal.

Table I compares a 500 megawatt oil-fired plant with a 500 megawatt plant converted to coal under different assumptions. All of the conversions are presently economic for a 20 or 15 year remaining plant life, and all but one are economic with only a 10 year remaining life. In the 20 year case, the savings range from 4.8 to 15.7 mills per kilowatthour (a mill is a tenth of a cent), or from 12 to 40% of the oil-fired plant's cost of electricity generation.

The analysis uses the delivered cost of coal to the Northeastern U.S., because this is the region where many of the coal-capable plants are located. The different cost assumptions reflect the varying degrees of conversion work which are necessary in practice; whether or not a plant needs a scrubber to remove sulfur dioxide depends largely on the air quality in its location (plants with scrubbers can burn higher sulfur coal, which is cheaper). The capacity factor will vary with the composition by fuel of the area's powerplants, though coal plants will generally operate at a higher capacity than oil plants, due to coal's lower cost.

Conversion costs are very plant-specific, and the figures for any particular plant will probably differ from those given here; these cases, however, should prove representative of the actual range of experience.

Table II compares the costs of an existing oil plant in 1990 with those of a new coal plant coming on line at that time (it takes approximately 8 years to site and construct a new coal-fired powerplant), broken down by location. The areas chosen are those whose utilities currently rely heavily on oil. With plausible assumptions about the future prices of oil and coal, new coal plants are economic in all of the regions shown. Rising oil prices make coal economic, unless its price also goes up exorbitantly.

The capital cost estimates have been escalated to reflect real increases between the present and actual construction. Fuel price differences reflect regional variation in type of coal and transportation cost. The pollution controls are those required by EPA's New Source Performance Standards (NSPS) for utility boilers (Southern California requires additional NOx controls to deal with particularly severe air quality problems). The calculations are for baseload operation, since this is the role new coal plants would play.

Oil plants are costed at both the present and the projected future price of oil. While oil would be economic in all of the cases except Texas if its price remained constant in real terms (all numbers in the tables are in contstant 1979 dollars), the comparison flips when the "middle" oil price forecast of the Administration's Import Reduction Task Force is used. Coal thus appears economic, even with conservative assumptions - the analysis has not even considered increases in oil prices after 1990, and coal plants will last for 40 years.

Some observers assert that coal and oil prices will move in lockstep. This, however, seem unlikely, given OPEC's control of the oil market and the excess supply prevailing in the coal market. As long as coal prices increase less rapidly than oil, coal becomes more and more economic.

Table III calculates the annual and total savings from coal conversions in the different cases. The total savings from the conversion of a single plant range from 80.5 to 338.1 million dollars.

Although, as this analysis shows, clean coal is economic, much of the potential use of coal by electric utilities has not occurred. This is due in part to uncertainties (regarding the reliability of supplies and the costs of extracting and transporting them), in part to the slowness with which competitive market forces affect behavior in a regulated industry, and occasionally to inappropriate rate-making procedures. Figure I illustrates two methods through which electricity rates can recover a capital investment. The declining rate method can make an investment which is cheaper in the long run seem more expensive in the short run, and thereby prevent it (for example, assume that the alternative to the $1000 investment described in the figure had an annual cost of $130).

A number of energy options will contribute to meeting the nation's needs, including conservation, solar, hydro, coal, and perhaps others. Clean coal can play a substantially greater role that it has to date.

Table I

Comparison of Operating Costs of Existing Oil Powerplant with Annualized and Operating Costs of Existing Oil Plant Converted to Coal 1/

(Mills/Kwh)

(Mid-year 1979$)

	Existing Oil, Current Price of Oil		Low Cost Conversion 2/		Low Cost 3/ Conversion with Scrubber		High Cost 4/ Conversion		High Cost 5/ Conversion with Scrubber	
Capacity Factor	65%	45%	65%	45%	65%	45%	65%	45%-	65%	45%
Boiler & ESP*	0	0	1.8	2.5	1.8	2.5	5.3	7.6	5.3	7.6
Scrubber	0	0	0	0	2.6	3.8	0	0	2.6	3.8
Total Annualized Capital Costs	0	0	1.8	2.5	4.4	6.3	5.3	7.6	7.9	11.4
Fuel Cost	36.8 6/	38.3 7/	19.0 8/	19.7 9/	16.6 10/	17.2 11/	19.0 8/	19.7 9/	16.6 10/	17.2 11/
O&M	0.5	0.7	2.5	2.8	5.0	5.6	2.5	2.8	5.0	5.6
Total (mills/Kwh)	37.3	39.0	23.3	25.0	26.0	29.1	26.8	30.1	29.5	34.2
Total, amortized over 15 yrs. 12/			23.6	25.5	26.9	30.4	27.8	31.6	31.1	36.5
Total, amortized over 10 yrs. 13/			24.3	26.6	28.6	32.9	29.9	34.7	34.3	41.1

* electrostatic precipitator

Notes for Table I

1/ Assumes a 10% capital charge in real terms and a 20 year amortization period (due to special tax advantages for expenditures on pollution controls, the actual capital charges will vary slightly with the portion of expenditure composed of pollution controls).

2/ Based on a capital cost estimate of $100/kw for boiler conversion and precipitator upgrade.

3/ Based on a capital cost estimate of $100/kw for boiler conversion and precipitator upgrade and $150/kw for retrofitted scrubber.

4/ Based on a capital cost estimate of $300/kw for boiler conversion and precipitator upgrade.

5/ Based on a capital cost estimate of $300/kw for boilers conversion and precipitator upgrade and $150/kw for retrofitted scrubber.

6/ Assumes the current delivered residual oil cost of $24.40/bbl (1% sulfur oil), heat content of 6.2 million Btu/bbl, and oil plant baseload heat rate of 9,340 Btu/kwh.

7/ Same as 6/, except for oil plant intermediate load heat rate of 9,732 Btu/kwh.

8/ Assumes delivered steam coal cost of $1.90/million Btu (medium sulfur coal in the Northeastern U.S.) and baseload heat rate for conversion without scrubber of 10,000 Btu/kwh. This figure ($1.90) is a levelized projected cost for coal delivered over a 30 year period, starting in 1985. (Source: ICF, Inc. Coal and Electric Utilities Model).

9/ Same as 8/, except for intermediate load heat rate for conversion without scrubber of 10,345 Btu/kwh.

10/ Assumes delivered steam coal cost of $1.60/million Btu (high sulfur coal in the Northeastern U.S.) and baseload heat rate for conversion with scrubber of 10,380 Btu/kwh. $1.60 is a levelized projected cost for coal delivered over a 30 year period, starting in 1985. (Source: ICF, Inc. Coal and Electric Utilities Model).

11/ Same as 10/, except for intermediate load heat rate for conversion with scrubber of 10,738 Btu/kwh.

12/ Assumes a 12% capital charge.

13/ Assumes a 16% capital charge.

Table II

Comparison of Operating Costs of Existing Oil Baseload Powerplant with Annualized Costs of New Coal Baseload Plant in Selected Regions 1/

(Mills/kwh)
(Mid-year 1979$)

	New Coal Plant					Existing Oil Plant	
	Texas	Florida	Northeast	Northern California	Southern California	Current Price of Oil	Projected Price of Oil
Base Plant	16.9	13.1	16.0	16.2	15.5	0	0
Transmission	2.0	2.0	2.0	2.0	2.0	0	0
Pollution Controls	3.7	3.7	3.7	3.7	4.3	0	0
Total Annualized Capital Costs 2/	22.6	18.8	21.7	21.9	21.8	0	0
Fuel Cost 3/	8.5	19.3	18.2	17.0	18.5	36.8 4/	48.2 5/
O&M	5.4	5.0	5.4	5.5	7.3	0.5	0.5
Total (Mills/Kwh)	36.5	43.1	45.3	44.4	47.6	37.3	48.7

Notes for Table II

1/ Assumes capital charges in real terms of 10% for base plant and transmission and 12.5% for pollution controls (due to their shorter amortization period). Capital cost estimates cited below were escalated for 5 years at 2.2% to reflect real cost increases between the present and actual construction.

2/ Based on the following capital cost estimates (unescalated 1979$):

<u>base plant</u>

Texas lignite	$841/kw
Florida bituminous	$653/kw
Northeast bituminous	$796/kw
N. Cal. sub-bituminous	$808/kw
S. Cal. bituminous	$772/kw

capacity penalty (derating due to pollution controls) 2.5%

transmission: $100/kw

pollution controls (including scrubber, electrostatic precipitator, and cooling tower): $150/kw
additional NOx controls in S. Cal: $ 25/kw (2 mills/kwh O&M)

3/ Based on the following estimates:

	delivered coal cost	heat rate*
Texas (high-sulfur bit.)	$0.80/million Btu	10,910
Florida (high-sulfur bit.)	$1.95/million Btu	9,884
Northeast (high-sulfur bit.)	$1.85/million Btu	9,832
N. Cal (low-sulfur sub-bit.)	$1.65/million Btu	10,300
S. Cal. (low-sulfur bit.)	$1.85/million Btu	10,016

These costs are levelized projected costs for delivered over a 30 year period, starting in 1990 (Source: ICF, Inc. Coal and Electric Utilities Model)

* Assumes energy penalty (energy used to operate scrubber) of 2.5% due to scrubber. ("high-sulfur" means 2-3% by weight).

4/ Assumes the current delivered residual oil cost of $24.40/bbl (1% sulfur oil), heat content of 6.2 million Btu/bbl, and oil plant baseload heat rate of 9,340 Btu/kwh.

5/ Assumes delivered residual oil cost of $32.00/bbl (1% sulfur oil) in 1990 (based on Import Reduction Task Force "middle" forecast crude price of $30/bbl), heat content of 6.2 million Btu/bbl, and oil plant baseload heat rate of 9,340 Btu/kwh.

Table III

Low Estimates of Annual and Total Savings From the Conversion to Coal of a 500 Mw Plant 1/
(million 1979$)

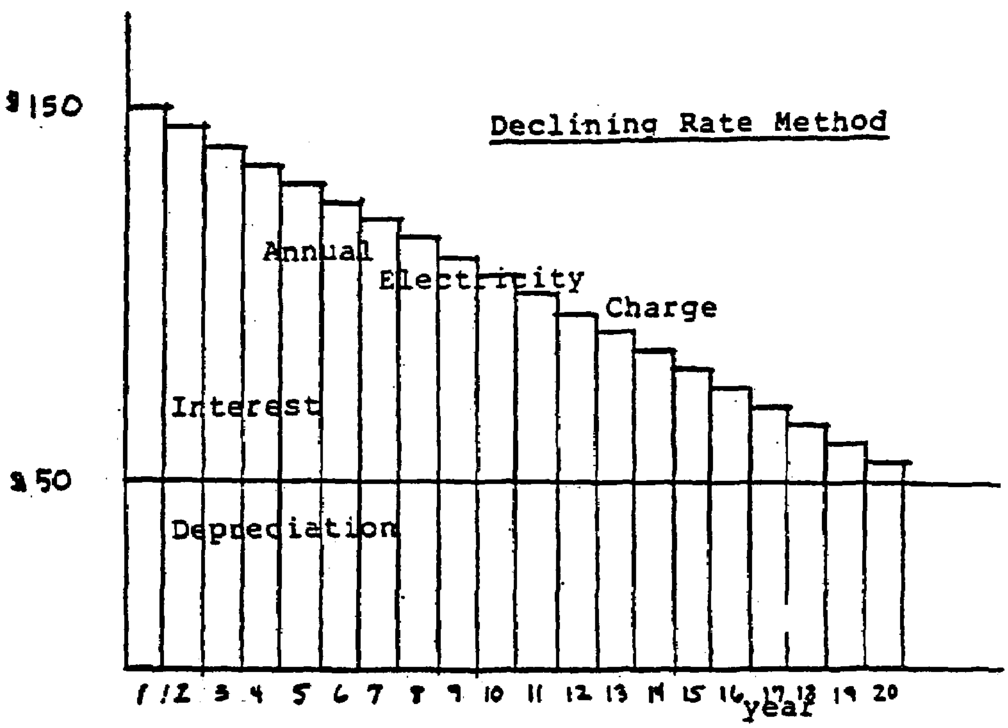
Case	Annual Savings	Present Value of Total Savings 2/
baseload operation		
low cost; w/o scrubber	$39.9	338.1
low cost; w/scrubber	32.2	272.9
high cost; w/o scrubber	29.9	253.4
high cost; w/scrubber	22.2	188.1
intermediate load operation		
low cost; w/o scrubber	27.6	233.9
low cost; w/scrubber	19.5	165.3
high cost; w/o scrubber	17.5	148.3
high cost; w/scrubber	9.5	80.5

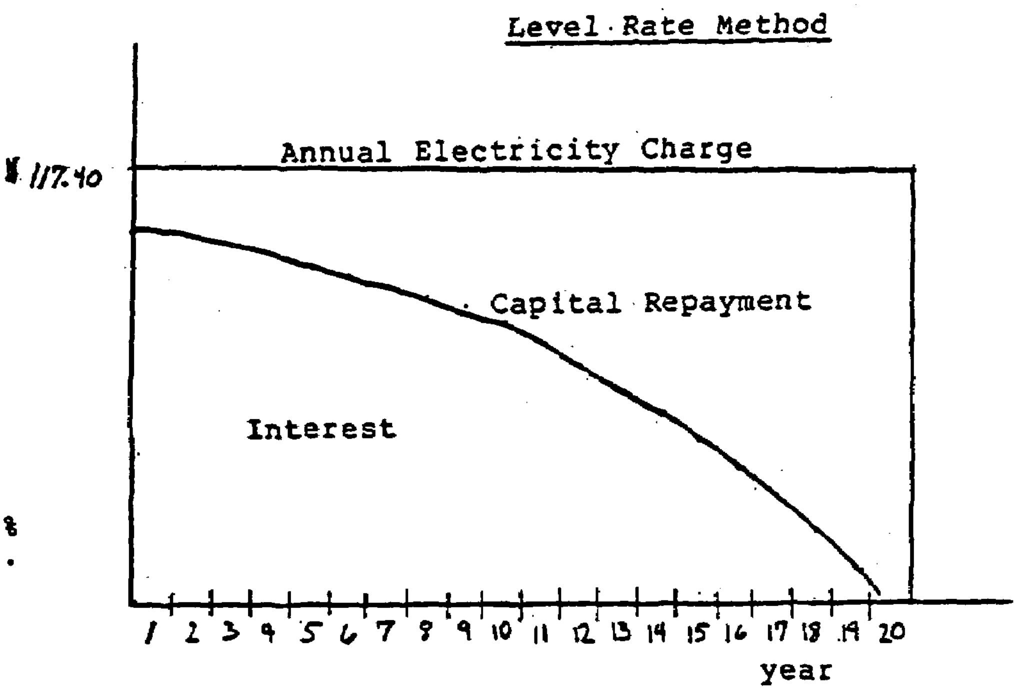
1/ "Low" because these estimates do not consider increases in oil prices over time.

2/ Discounted at 10% in real dollars, assuming 20 year plant life.

FIGURE 1

COMPARISON OF TWO UTILITY COST ALLOCATION METHODS FOR A $1000 INVESTMENT WITH A 20 YEAR LIFE1/





1/ Assumes 10% interest rate.