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ANALYSIS OF STANDARDS FOR
ENERGY-EFFICIENT MOTORS

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Prepared by:

ENERGY AND ENVIRONMENTAL ANALYSIS, INC.
1111 North 19th Street
Arlington, Virginia 22209

MASTER

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ANALYSIS OF STANDARDS FOR ENERGY EFFICIENT MOTORS

This analysis does not lead to a clear conclusion regarding the effectiveness of standards for energy efficient motors if effectiveness is based on a benefit-cost ratio criteria. Two alternative assumptions were made regarding the appropriate measure of the costs to the private sector. In the first case it was assumed that private sector users have no biases and expect rates of return on investment that represent their true opportunity cost of capital. That is to say, they require the rate of return on an investment in an energy efficient motor to match the next best alternative use of investment dollars. Forcing private sector users to purchase more efficient motors than they would in a "free market" circumstance will incur additional costs to those users. Part of the additional cost is the foregone return on alternative investments as capital is diverted from productive uses. Furthermore, this foregone return on investment represents part of the real cost of the regulation to society. Under this assumption the benefit-cost ratio is .65, that is, for every dollar of cost incurred, the associated benefit is 65 cents.

The alternative assumption is that the private sector under values energy conservation investments. The reasoning underlying this alternative assumption is that benefits to society of conservation investments are not reflected in the return to investment, therefore, the private sector uses an unrealistically high hurdle rate of return for energy conservation investments, and that the real cost of the investment to society is represented by a cost of capital significantly lower than the private sector requires. Under this assumption, the benefit-cost ratio of the standards program was 1.35. For every dollar spent, \$1.35 is returned to society, because the standards force private sector users to correct their biases and therefore allocate capital more productively.

Unfortunately, the benefit cost ratios do not provide any clear cut determination of which action (to adopt or not adopt the regulation) provides the least risk, because: (1) the magnitudes of the results for the two alternatives are equal in opposite directions, and (2) there is no basis to judge the probability of correctness for either assumption and they must be considered equally probable. Therefore, the results of the benefit-cost analysis are essentially indeterminant, given the state of information.

Beyond looking at the benefit-cost ratios, there are several other criteria which speak to the effectiveness of the motor efficiency regulation. Figure 1 shows the impact on total electricity consumption in motors (5-125 HP) under alternative market penetration assumptions. Of particular interest is the difference in total electricity consumption between the two extremes. The "standards case" represents the consumption of electricity if all growth and replacement motors were energy efficient i.e., if the regulation was implemented. The "no efficient motors case" represents the consumption of electricity if no new energy efficient motors were purchased, and all growth and replacement motors had the same energy efficiency as the energy inefficient motors. The difference in electricity consumption under these alternative scenarios is only .117 and .170 quads of electricity in the years 1990 and 2000 respectively. Since these two cases represent the two extremes of market penetration, the actual difference between any free market case and the regulation would be less than this insignificant optimum. Therefore, whatever the level of market penetration of energy efficient motors, the impact of the regulation on electricity consumption is not dramatic.

The "free market case" is the market penetration projection assuming that the private sector selects efficient motors based on the benefits and costs to the firm. This case was the basis of the benefit-cost ratios described above. It assumed an after tax hurdle rate of return of 33 percent. This is a conservative (high) hurdle rate of return

FIGURE 1
ELECTRICITY CONSUMPTION IN MOTORS
5 HP-125 HP

estimate. The competitiveness of energy efficient motors under this hurdle rate is illustrated in Figure 2. In 1985 the market penetration of efficient motors exceeds 60 percent and levels off at about 65 percent. It is important to note that market penetration is defined not as the total quantity of sales, but the percentage of shaft power supplied by efficient motors (the latter is a more meaningful measure of market penetration than the former).

Tables 1-A and 1-B indicate the degree to which certain applications of motors are penalized when forced to use efficient motors. Table 1-A shows the average price of electricity required to recover (through electricity savings) the difference in capital cost. The low utilization levels are penalized most, requiring electricity prices in excess of \$23/MMBtu (1977 \$s) to breakeven. This is to be compared with current prices of about \$10/MMBtu (1977 \$s). Table 1-B shows the percentage of the total population in each size and utilization category in Table 1-A. For instance nearly 22 percent of the small motor users would face the \$23.90/MMBtu breakeven price. (Table 1-A breakeven prices are calculated assuming a cost of capital of 15 percent, not the 33 percent used in the market penetration analysis).

Table 2 contains the input assumptions used to characterize both the efficient and inefficient motors for the market competition analysis. The electricity prices used in the analysis were taken from the Energy Information Administrations 1980 base case.

FIGURE 2
PERCENTAGE OF MARKET SHARE WON
BY ENERGY EFFICIENT MOTORS*

*Market share is defined as the percentage of total shaft output provided by energy efficient motors for growth demand and replacement motors, i.e., existing capital stock is not included.

TABLE 1-A
Average Breakeven Price of Electricity
for Energy Efficient Motors

(\$/MMBtu in 1977\$)

Size in HP

10

30

87.5

Utilization
(Hours/Year)

0-1,000 (500)	23.90	28.40	34.20
1,001-1,500 (1250)	9.56	11.36	13.68
1,501-2,000 (1759)	6.83	8.11	9.77

TABLE 1-B
Percentage Population in Each
Size-Utilization Category

Size in HP

10

30

87.5

0 - 1,000
1,001 - 1,500
1,501 - 2,000
Cumulative %

21.8	3.6	2.0
29.8	13.3	5.2
29.9	13.3	5.2
82%	30%	12%

TABLE 2

Input Assumptions for Motor Characteristics

Size Ranges HP	5.1-20	21-50	51-125
Prototype Motor HP	10	30	87.5
KW	7.457	22.371	65.249
Capital Cost (\$/KW) (1977 \$s)			
Standard Motor	53.64	44.70	54.02
Efficient Motor	79.39	59.99	63.76
Energy Efficiency (%)			
Standard Motor	82.5	87.5	91.0
Efficient Motor	89.0	91.0	93.0
Utilization Rate (hrs/yr)			
Low Use	1000	1500	2000
Expected Use	1500	2900	3600
High Use	3000	6000	6000
Useful Life	Size		
Utilization	10	30	87.5
Low	16	16	16
Expected	16	15	15
High	15	14	14

FUEL PRICES - EIA BASE CASE

(\$/MMBtu - 1977 \$)

	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>
Coal	1.66	1.90	2.01	2.11	2.23
Oil	3.83	5.16	5.77	6.42	7.19
Natural Gas	2.67	3.73	4.53	5.04	5.61
Electricity	8.96	10.06	10.37	10.42	10.76