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Analysis Report

**Replacement Energy Costs in the
Residential and Commercial Sector
1985, 1990 and 1995**

July 1980

U.S. Department of Energy
Energy Information Administration
Assistant Administrator for Applied Analysis
Washington, D.C. 20461

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Replacement Energy Costs in the Residential and Commercial Sector 1985, 1990 and 1995

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July 1980

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PREFACE

The Office of the Assistant Secretary for Policy and Evaluation requested the Assistant Administrator for Applied Analysis to assist in developing "energy replacement costs." For this analysis, energy replacement costs are defined to be the marginal costs of energy, excluding various energy taxes and subsidies, plus a premium on oil to reflect the costs associated with the U.S. dependence on foreign oil. This effort is being undertaken as a part of a larger effort to implement the Building Energy Performance Standards (BEPS) that are part of the Energy Conservation and Production Act of 1976.

This report describes the procedures used to determine the energy replacement costs and the calculations involved. The assumptions contained in this analysis were specified by the Office of Policy and Evaluation and the results of this analysis are directly determined by these assumptions. As a result, this report will present estimates of energy replacement costs and describe the procedures and calculations used to obtain these estimates but will not contain an extensive analysis of the results themselves.

Mark Rodekohr prepared this report with the assistance of Ann Siler and the typing support of Hattie Ramseur. Julie Zalkind, Robert Eynon, and Fred Murphy were particularly helpful in answering numerous questions that arose in the analytic process.

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SUMMARY

This analysis was requested by Dr. David Montgomery, Deputy Assistant Secretary for System Analysis, Office of Policy and Evaluation, U.S. Department of Energy for use in a larger study concerning the formulation of the Building Energy Performance Standards (BEPS).

For this analysis energy replacement costs are defined as:

"Replacement costs are the costs to the nation providing the consumer with an additional unit of a given form of energy, excluding energy related subsidies and taxes and including the value of selected externalities."¹

The Office of Policy and Evaluation provided the assumptions as to which taxes, subsidies, and externalities were to be included in this definition. The marginal energy prices used in this analysis are based on the Energy Information Administration (EIA) Midterm Energy Forecasting System (MEFS) analysis which appears in the Annual Report to Congress 1979, Volume 3 (forthcoming), and are currently documented in EIA Service Report SR/IA/80-01, "Preliminary 1985, 1990, and 1995 Energy Forecasts for the Annual Report to Congress, 1979."

¹Midterm Analysis Division, Office of Applied Analysis, Energy Information Administration, Projecting Marginal Energy Using the Midterm Energy Forecasting System (Washington, D.C.: U.S. Department of Energy, 1979).

The taxes and subsidies excluded in this analysis are intangible drilling allowances, differential royalty fees, coal severance taxes, and the black lung tax. The externality included in the analysis is an oil import premium of \$3.00 per barrel (real 1978 dollars).

The results of this analysis show that:

- Energy replacement costs of all fuels are expected to grow in real terms over the 1985 to 1995 time period, with natural gas experiencing the largest growth rate and electricity experiencing the lowest growth rate. The large growth rate of natural gas prices is due to the wellhead price decontrol provisions of the Natural Gas Policy Act of 1978. The incremental pricing provisions of this legislation keeps the average natural gas price well below the the marginal natural gas price. The low growth rate of electricity replacement cost is due to a relatively (to recent history) small demand for new capital equipment expenditures in this sector which are, in turn, due to the relatively (to recent history) low electricity demand growth rate; and,
- Regional variation in electricity prices is overstated due to the modeling assumption that electricity cannot be sold between regions. This assumption implies that all power produced in a region can only be sold in that region when, in fact, electricity is often sold between regions. Interregional selling and production of electricity tends to make regional price differences lower than what appears in this analysis.

1. INTRODUCTION

This paper presents an analysis of energy replacement costs based on the Energy Information Administration's Annual Report to Congress, 1979, Volume three (forthcoming).

The Department of Energy is required to design a set of standards specifying the energy efficiency of new buildings. This design is to be based on economic factors, one of the most important being an estimate of future energy prices. This paper documents the calculations and development of the prices which are being considered for use in this project.

The calculation of replacement costs is based on the addition or subtraction of the appropriate tax, subsidy or externality² from marginal retail energy prices. Marginal, rather than market energy prices, are used as the starting point for this analysis because they reflect the incremental cost to the consumer for using an additional unit of energy and, therefore, more fully reflect societies' incremental cost (benefit) of saving an additional unit of energy. Market prices are not appropriate because they are influenced by numerous regulations that prevent producers from charging the incremental cost of producing one more unit of energy. For example, it would

²In this analysis, an externality is defined as some cost which is not included, or external to the cost of a product. A common example of an externality is the pollution cost associated with steel production or electricity generation.

be clearly incorrect to use market natural gas prices because these are well below the marginal prices, due to the incremental pricing provisions of the Natural Gas Policy Act (NGPA) of 1978. To use market natural gas prices in the Building Energy Performance Standards (BEPS) analysis would underestimate the value of the energy saving to society, because the natural gas that is being saved is the more expensive marginal gas which costs more than producers can charge under the NGPA. Similar problems occur for electricity prices which are based on average costs.

The marginal price includes the acquisition cost of producing or importing the marginal unit of energy, transportation costs to the final consumers, refining or other conversion costs, and wholesale and retail markups. For electricity, the marginal price is determined as a function of the marginal cost of the fuel used to generate the marginal unit of electricity and the capital cost of the marginal generation, operating, transmission, and distribution costs. A more complete discussion of the determination of marginal prices appears in the Energy Information Administration (EIA) Analysis Report, Projecting Marginal Energy Costs Using the Midterm Energy Forecasting System. The first adjustment requires that prices be modified to subtract certain taxes and subsidies that are unique to the energy industry, but which are not levied to correct for externalities unique to the energy market.

Examples of such taxes are the State severance taxes on coal production. All other taxes and subsidies currently included in the marginal price but not discussed in this paper, are assumed to remain in effect. The second adjustment requires that an additional fee or tax representing externalities, which are currently not accounted for, be added to the marginal price. Examples of such adjustments are the import premium placed on imported oil, which is designed to account for the macroeconomic and national security costs associated with oil imports.

Both marginal and replacement cost prices are presented for each of ten Department of Energy regions and the total United States for 1985, 1990, and 1995. The energy products considered in this analysis are distillate oil, liquid gases, natural gas, and electricity in the residential sector and distillate oil, liquid gases, natural gas, residual oil, and electricity in the commercial sector. The marginal price forecasts are taken from the Midterm Energy Forecasting System (MEFS) analysis presented in Volume Three of the EIA Annual Report to Congress, 1979.

All of the following analyses are based on a set of clearly specified assumptions provided by the Office of Policy and Evaluation. This paper will not discuss the reasonableness of such assumptions but merely use these assumptions to

calculate the resulting energy replacement costs. This paper is one of a series of such analyses already completed on this subject. The other analyses are documented in the following EIA Analysis Reports, Marginal Costs of Energy in 1979, Estimates by Economic Sector and Fuel Type, October 1979; Projecting Marginal Energy Costs Using the Midterm Energy Forecasting System, October 1979; and Estimates of Energy Non-Resource Costs; Energy Taxes and Subsidies, November 1979.

The remainder of this paper will discuss the assumptions, methodology, results, and analysis limitations. The Appendix presents the analysis documentation which allows knowledgeable readers to reproduce the results.

Assumptions

As previously stated, the Office of Policy and Evaluation provided the assumptions for this analysis. The major assumptions, critical to the analysis, are:

- The medium world oil prices presented in the EIA Annual Report to Congress, 1979, are assumed to hold in the 1985 through 1995 time period. In 1979 dollars per barrel, this assumption results in oil costing \$32.00 for 1985, \$37.00 for 1990, and \$41.00 for 1995.
- A \$3.00 per barrel (1978 dollars) import premium is sufficient to reflect national defense and other externalities associated with importing oil. This figure is assumed to remain constant in real terms in 1985, 1990, and 1995.

- Taxes and subsidies reasonably unique to the energy sector, which are not designed to correct for any externality, are excluded from calculations of the marginal replacement cost price. These taxes must be unique to the energy sector and do not include taxes that are applied to all other sectors of the economy. The taxes and subsidies excluded are the intangible drilling allowances, the coal severance tax, the differential royalties, and the black lung tax; and
- All other government programs, such as the Natural Gas Policy Act of 1978, remain in effect for the purposes of calculating the marginal and, eventually, the replacement cost of energy. This analysis assumed that Phase II of the incremental pricing provision of the NGPA would be implemented. Recently it was decided that this phase would not be implemented. As point out in Chapter 1, Volume II of Energy Programs/Energy Markets (a forthcoming EIA study), this change in assumptions will have a very minor impact on marginal prices.

For a more detailed discussion of the world oil price and other assumptions embodied in the marginal price forecast, see the EIA Service Report, SR/IA/80-01, Preliminary 1985, 1990, and 1995 Energy Forecasts for the Annual Report to Congress, 1979."

2. METHODOLOGY

To obtain replacement costs from the marginal prices produced from MEFS, two types of adjustments are made. These two adjustments are a tax adjustment and oil import premium adjustment. The specific adjustments made to each fuel are discussed in turn.

For petroleum products only the oil import premium adjustment is made to the marginal price. The tax adjustments were excluded because petroleum product marginal prices are based solely on the cost of imported oil and, therefore, are unaffected by any taxes imposed by Federal or State governments. The oil import premium is assumed to consist of a \$3.00 per barrel (1978 dollars) premium which is fully passed through on a per barrel basis to all petroleum products. It is further assumed that this premium will remain fixed in real terms over the forecast period.

For natural gas, both a tax adjustment and oil import premium adjustment is made to the marginal prices. In this case the tax adjustment subtracts from the marginal price intangible drilling allowances and differential royalty fees. Intangible drilling allowances represent a special tax treatment of intangible (or not salvageable) drilling costs which allow producers to either deduct all of the costs in the year in which they were incurred or capitalized these costs over a longer period of time. The elimination of

these allowances tend to increase the cost of production. Differential royalties refer to some states imposing additional royalty fees over and above the standard 12.5 percent as a special type of tax. The elimination of this tax would tend to lower the cost of the production. As shown in the next section, the combined effect of both of these adjustments is to increase the cost of production. This increase implies that the intangible drilling allowance adjustment is greater than the differential royalty adjustment. As in the case of petroleum products, the oil import premium is assumed to be fully passed through since petroleum products and natural gas are close substitutes.

For coal, the tax adjustment consists of modifications to account for the existence of the State severance tax and the black lung tax. State severance taxes are levies placed on the production of coal by certain States. The black lung tax is a Federal tax amounting to \$0.25 per ton for surfaced-mined coal and \$0.50 per ton underground-mined coal. This tax is used to help treat miners who have contracted black lung disease.

To calculate the electricity price replacement costs the following methodology was used:

- The tax, subsidy, and import premium adjustments are added to the marginal input fuel prices (i.e., the prices electric utilities pay for their fuels) for coal, distillate oil, residual oil, and natural gas;
- The difference in dollars per million Btu between the unadjusted and adjusted (for tax, subsidies, and import premium) marginal fuel price is calculated and multiplied times the quantity of each fuel consumed by electric utilities to calculate the increase in total costs to the utility for each fuel;
- The increased cost for each fuel is summed over all fuels to arrive at the total increase in fuel costs; and,
- The total increased fuel cost is divided by total generation to produce the increase in price necessary to cover the increased cost.

This increase in price is then added to the marginal electricity price to produce the replacement cost of this fuel. This method of calculation implicitly assumes that:

- The proportion of each fuel is used in the generation of electricity by mode (seasonal peak, daily peak, intermediate, and base) does not change; and,
- The fraction of total generation by mode does not change.

3. RESULTS OF ANALYSIS

The results of this analysis are detailed in Tables 1 through 7 for petroleum products and natural gas in the residential and commercial sectors. These tables express all prices in terms of 1979 dollars per million Btu. In the residential sector, replacement costs for distillate fuel increase from \$7.20 per million Btu in 1985 to \$8.74 per million Btu in 1995. The prices for liquid gases exhibit a similar trend but are generally higher than distillate prices, reflecting the historic difference between distillate and liquid gas prices. Residential natural gas prices are lower than the distillate price and rise from a 1985 figure of \$5.62 per million Btu to \$7.04 per million Btu in 1995. Using residual fuel in the commercial sector as a proxy for a general oil price, residential natural gas prices are \$0.50 per million Btu lower than the oil price proxy in 1985 and \$0.30 per million Btu lower in 1995. The difference in the natural gas and oil prices is primarily due to the fact that these fuels are close, but not perfect substitutes, because of availability (natural gas can only be obtained in those areas of the country serviced by a pipeline). These data also show that the tax and subsidy adjustments are smaller than the import premium, which amounts to \$0.56 per

Table 1. Residential Sector: Distillate
(1979 \$/Million Btu)

	Region										
	New England	New York/ New Jersey	Mid- Atlantic	Mid- West	South- west	Mid- West	Central	North Central	West	North- west	United States
1985											
Marginal Fuel Price	6.62	6.71	6.91	6.99	6.39	6.63	6.33	6.46	6.24	6.24	6.64
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	7.18	7.27	7.47	7.55	6.95	7.19	6.89	7.02	6.80	6.80	7.20
1990											
Marginal Fuel Cost	7.47	7.56	7.75	7.84	7.23	7.48	7.17	7.25	7.09	7.09	7.50
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	8.03	8.12	8.31	8.40	7.79	8.04	7.73	7.81	7.65	7.65	8.06
1995											
Marginal Fuel Price	8.13	8.22	8.43	8.51	7.91	8.15	7.84	7.92	7.75	7.75	8.18
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	8.69	8.78	8.99	9.07	8.47	8.71	8.40	8.48	8.31	8.31	8.74

Table 2. Residential Sector: Liquid Gases
(1979 \$/Million Btu)

	Region										
	New England	New York/ New Jersey	Mid- Atlantic	South Atlantic	Mid- West	South- west	Central	North Central	West	North- west	United States
1985											
Marginal Fuel Price	7.55	7.68	8.02	8.02	7.64	7.58	7.57	7.80	7.60	7.60	7.72
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	8.11	8.24	8.58	8.58	8.20	8.14	8.13	8.36	8.16	8.16	8.28
1990											
Marginal Fuel Price	8.92	9.05	9.39	9.39	9.02	8.95	8.94	9.17	8.97	8.97	9.10
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	9.48	9.61	9.95	9.95	9.58	9.51	9.50	9.73	9.53	9.53	9.66
1995											
Marginal Fuel Price	9.67	9.80	10.14	10.14	9.72	9.70	9.64	9.87	9.72	9.72	9.82
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	10.23	10.36	10.70	10.70	10.28	10.26	10.20	10.43	10.28	10.28	10.38

Table 3. Residential Sector: Natural
(1979 \$/Million Btu)

	New England	New York/ New Jersey	Mid- Atlantic	South Atlantic	Mid- West	South- west	Central	North Central	West	North- west	United States
1985											
Marginal Fuel Price	5.66	5.59	5.02	4.70	4.62	4.14	4.47	4.16	5.09	5.51	4.78
+ Tax Adjustment	.29	.29	.28	.27	.28	.27	.28	.27	.29	.28	.28
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	6.51	6.44	5.86	5.53	5.46	4.97	5.31	4.99	5.94	6.35	5.62
1990											
Marginal Fuel Price	6.79	6.71	6.13	5.77	5.69	5.14	5.43	4.99	5.95	6.37	5.81
+ Tax Adjustment	.31	.30	.30	.29	.30	.30	.29	.28	.30	.30	.30
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	7.66	7.57	6.99	6.62	6.55	6.00	6.33	5.83	6.81	7.23	6.67
1995											
Marginal Fuel Price	7.20	7.11	6.52	6.16	6.08	5.51	5.86	5.32	6.20	6.76	6.18
+ Tax Adjustment	.31	.30	.30	.29	.30	.30	.29	.28	.30	.30	.30
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	8.07	7.97	7.38	7.01	6.94	6.37	6.71	6.16	7.06	7.62	7.04

Table 4. Commercial Sector: Distillate
(1979 \$/Million Btu)

	Region										United States
	New England	New York/ New Jersey	Mid-Atlantic	South Atlantic	Mid-West	South-west	Central	North Central	West	North-west	
1985											
Marginal Fuel Price	6.35	6.43	6.47	6.48	6.18	6.35	6.13	6.21	5.93	5.93	6.32
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	6.91	6.99	7.03	7.04	6.74	6.91	6.69	6.77	6.49	6.49	6.88
1990											
Marginal Fuel Price	7.20	7.27	7.32	7.32	7.03	7.19	6.97	6.99	6.78	6.78	7.16
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	7.76	7.83	7.88	7.88	7.59	7.75	7.53	7.55	7.34	7.34	7.72
1995											
Marginal Fuel Price	7.86	7.94	7.99	8.00	7.70	7.86	7.65	7.66	7.43	7.43	7.82
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	8.42	8.50	8.55	8.56	8.26	8.42	8.21	8.22	7.99	7.99	8.38

Table 5. Commercial Sector: Residual
(1979 \$/Million Btu)

	Region										
	New England	New York/ New Jersey	Mid- Atlantic	South Atlantic	Mid- West	South- west	Central	North Central	West	North- west	United States
1985											
Marginal Fuel Price	5.51	5.60	5.93	5.50	5.52	5.51	5.56	5.40	5.19	5.01	5.54
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	6.07	6.16	6.49	6.06	6.08	6.07	6.12	5.96	5.75	5.57	6.10
1990											
Marginal Fuel Price	6.20	6.31	6.65	6.24	6.26	6.25	6.30	6.09	5.95	5.76	6.24
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	6.76	6.87	7.21	6.80	6.82	6.81	6.86	6.65	6.51	6.32	6.80
1995											
Marginal Fuel Price	6.76	6.86	7.20	6.80	6.88	6.87	6.92	6.70	6.55	6.36	6.79
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.55	0.56	0.56	0.56	0.56
= Replacement Cost	7.32	7.42	7.76	7.36	7.44	7.43	7.43	7.26	7.11	6.92	7.35

Table 6. Commercial Sector: Liquid Gases
(1979 \$/Million Btu)

	Region										
	New England	New York/ New Jersey	Mid- Atlantic	South Atlantic	Mid- West	South- west	Central	North Central	West	North- west	United States
1985											
Marginal Fuel Price	7.55	7.68	8.02	8.02	7.64	7.58	7.57	7.80	7.60	7.60	7.70
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	8.11	8.24	8.58	8.58	8.20	8.14	8.13	8.36	8.16	8.16	8.26
1990											
Marginal Fuel Price	8.92	9.05	9.39	9.39	9.02	8.95	8.94	9.17	8.97	8.97	9.06
+ Import	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	9.48	9.61	9.95	9.95	9.58	9.51	9.50	9.73	9.53	9.53	9.62
1995											
Marginal Fuel Price	9.67	9.80	10.14	10.14	9.72	9.70	9.64	9.87	9.72	9.72	9.79
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	10.23	10.36	10.70	10.70	10.28	10.26	10.20	10.43	10.28	10.28	10.35

Table 7. Commercial Sector: Natural Gas
(1979 \$/Million Btu)

	Region										
	New England	New York/ New Jersey	Mid- Atlantic	South Atlantic	Mid- West	South- west	Central	North Central	West	North- west	United States
1985											
Marginal Fuel Price	4.92	4.92	4.50	4.13	4.26	3.54	4.02	3.91	4.51	4.86	4.26
+ Tax Adjustment	.29	.29	.28	.27	.27	.27	.27	.27	.29	.28	.28
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	5.77	5.77	5.34	4.96	5.09	4.37	4.85	4.74	5.36	5.70	5.10
1990											
Marginal Fuel Price	6.05	6.04	5.61	5.20	5.32	4.55	5.03	4.73	5.37	5.71	5.30
+ Tax Adjustment	.31	.31	.30	.30	.30	.28	.29	.29	.30	.30	.30
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	6.92	6.91	6.47	6.06	6.18	5.39	5.88	5.58	6.23	6.57	6.16
1995											
Marginal Fuel Price	6.46	6.44	6.00	5.59	5.71	4.92	5.41	5.07	5.62	6.10	5.67
+ Tax Adjustment	.31	.31	.30	.30	.30	.28	.29	.29	.30	.30	.30
+ Import Premium	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
= Replacement Cost	7.33	7.31	6.86	6.45	6.57	5.76	6.26	5.92	6.48	6.96	6.53

million Btu. The positive tax adjustment indicates that the intangible drilling allowance is greater than the differential royalty fee, since the fee has a negative sign. Examination of the regional differences in replacement costs shows that residential distillate fuel is most expensive in the Mid- and South Atlantic regions and is least expensive in the Northwest. For residential natural gas, the regional pattern is somewhat different with the most expensive regions being New England and New York/New Jersey and least expensive regions being the Southwest and North Central.

The commercial sector exhibits similar trends as those discussed with respect to the residential sector. The replacement costs of all petroleum products and natural gas grow over time with the growth rate in natural gas being higher than for oil product prices. From 1985 to 1995, commercial sector natural gas prices grow at an annual rate of 2.5 percent while commercial sector distillate prices grow at an annual rate of 2.0 percent. This differential in the growth rates of these two price series is due to the NGPA which provides for incremental pricing of natural gas in these two sectors. In terms of the most expensive and least expensive regions, the regional trends in the commercial sector are identical to those discussed, with respect to the residential sector.

The electricity price calculations are detailed in Tables 8 through 10 for both residential and commercial sectors. These tables show the incremental cost of the fuels used by the utilities due to the tax and import premium adjustments and increase in electricity prices. The tables also show the replacement costs of electricity for both sectors. Both the residential and commercial sectors exhibit similar trends. The growth in electricity prices is the lowest of any of the fuels, with the average annual growth rate being 0.5 per cent. This can be explained by the fact that the demand for electricity is forecast to grow much more slowly than experienced in the past, and that little capital expansion is needed to meet this demand and, therefore, the capital cost component of electricity generation (even on the margin) is relatively small.

In regional terms, these prices show a great variance across all regions. This large dispersion is due to a lack of regional detail in the analysis process. In this analysis it is assumed that all power generated in a region must be consumed in that region. Therefore, no electricity sales from one region to another was permitted. This means that the marginal electricity prices are based on the most expensive generation in the particular region. However, it is quite common for generation from a plant in one region to be wholly devoted to satisfying the demand in another region. In the

Table 8. Electricity
(1979 \$/Million Btu)

	Region										United States
	New England	New York/ New Jersey	Mid-Atlantic	South Atlantic	Mid-West	South-west	Central	North Central	West	North-west	
1985											
Increased Cost of: (Millions of 1979 \$)											
Coal	93	470	1,442	2,449	2,496	1,083	591	304	283	146	9,212
Distillate	33	3	45	-	21	-	-	-	16	-	119
Residual	254	36	65	-	19	-	-	-	254	-	626
Natural Gas	44	105	16	180	53	1,393	37	-	358	-	2,062
Total	424	614	1,566	2,679	2,589	2,476	628	304	911	146	12,062
+ Total Generation	331	503	953	1,819	1,690	1,132	383	204	791	523	8,328
= Increased Price (1979 \$/MM Btu)	1.28	1.22	1.64	1.47	1.53	2.19	1.64	1.49	1.15	.28	1.44
+ Marginal Residential Price	30.11	21.96	19.19	15.43	16.78	14.79	11.06	8.33	19.31	11.95	16.79
= Residential	31.29	23.18	20.83	16.90	18.31	16.98	12.70	9.82	20.46	12.23	18.23
+ Marginal Commercial Price	29.80	20.83	18.79	15.78	16.35	13.74	10.15	7.06	20.37	11.74	16.52
= Commercial Replacement Cost	31.08	22.10	20.43	17.25	17.88	15.93	11.79	8.55	21.52	12.02	17.96

Table 9. Electricity
(1979 \$/Million Btu)

		Region									United States	
		New England	New York/ New Jersey	Mid-Atlantic	South Atlantic	Mid-West	South-west	Central	North Central	West		North-west
1990												
Increased Cost of:												
(Millions of 1979 \$)												
Coal	187	510	1,633	3,035	2,716	1,412	653	459	390	146	11,075	
Distillate	27	-	53	-	36	-	-	-	16	-	132	
Residual	154	5	76	10	19	-	-	-	331	-	596	
Nat'l Gas	22	69	34	297	73	1,442	129	-	385	2	2,373	
Total	390	584	1,796	3,342	844	2,854	782	459	122	148	14,176	
÷ Total Generation	393	576	1,131	2,251	1,973	1,390	455	257	967	587	9975	
= Increased Price	.99	1.02	1.59	1.49	1.44	2.05	1.72	1.79	1.16	.25	1.42	
20												
+ Marginal Residential Price	29.73	19.25	22.02	17.39	18.65	18.57	15.75	3.46	22.59	15.88	19.01	
= Residential Replacement Cost	30.72	20.27	23.61	18.83	20.09	20.62	17.47	10.25	23.75	16.13	20.43	
+ Marginal Commercial Price	29.42	18.17	21.63	17.74	18.21	17.51	14.84	7.19	23.65	15.67	18.74	
= Commercial Replacement Cost	30.41	19.19	23.22	19.23	19.65	19.56	16.56	8.98	24.81	15.92	20.16	

Table 10. Electricity
(1979 \$/Million Btu)

		Region										
		New England	New York/ New Jersey	Mid- Atlantic	South Atlantic	Mid- West	South- west	Central	North Central	West	North- west	United States
1995												
Increased Cost of:												
(Millions of 1979 \$)												
Coal		325	525	2,051	3,311	3,032	2,179	687	661	1,018	146	13,803
Distillate		13	-	-	-	42	-	-	-	-	-	55
Residual		24	5	13	22	19	-	-	-	-	-	83
Natural Gas		7	83	14	312	73	824	169	-	210	-	1,647
Total		369	613	2,077	3,645	3,166	3,003	856	661	1,228	146	15,588
21	÷ Total Generation	470	625	1,282	2,650	2,214	1,703	517	327	1,143	622	11,553
	= Increased Price (1979 \$/MM Btu)	.79	.98	1.62	1.38	1.43	1.76	1.66	2.02	1.07	.23	1.35
	+ Marginal Resi- dential Price	21.01	21.74	18.59	17.79	18.81	17.44	18.95	11.84	17.47	11.15	17.85
	= Residential Replacement Cost	21.80	22.72	20.21	19.17	20.24	19.20	20.61	13.86	18.54	11.38	19.20
	+ Marginal Com- mercial Price	20.70	20.66	18.19	18.14	18.37	16.39	18.04	10.57	18.52	10.95	17.59
= Commercial Replacement Cost		21.49	21.64	19.81	19.52	19.80	18.15	19.70	12.59	19.59	11.18	18.94

forecast period an increase in demand in one region, which could have been satisfied with excess capacity in another region, is not permitted, therefore, a new plant must be built in the region experiencing the demand growth incurring greater capital costs and causing the variation in regional prices to be larger than would otherwise have been the case.

Analysis Limitations

This analysis is based on a number of assumptions specified by the Office of Policy and Evaluation. Differences in these assumptions could change the results of this analysis. Further, there is uncertainty with respect to the analytic structure (MEFS), underlying data and estimated parameters within MEFS which add an additional level of uncertainty in the results of this analysis. In addition, this analysis assumes that oil and natural gas compete for the same market but are not perfect substitutes. The lack of perfect substitution is due to constraints on the availability of natural gas, because a costly transmission network is necessary for natural gas and other factors. If these two fuels were perfect substitutes, they would sell for the same price and would equilibrate on the imported oil price. One of the most important assumptions used in this analysis concerns the assumed level of world oil prices. A discussion of the world oil price assumptions and the other critical assumptions such as can be found in the EIA Annual Report to Congress, 1979, Volume Three (forthcoming).

Additional limitations, particular to the replacement cost, calculations should also be made. The major limitation concerns the regional variation in electricity prices. This regional variation is probably overstated as a result of the analysis structure and, therefore, the regional electricity prices should be viewed with caution.

APPENDIX
ANALYSIS DOCUMENTATION

The analysis presented in this paper was completed with the use of the Midterm Energy Forecasting System (MEFS) and some additional, simple arithmetic calculations. The assumptions and MEFS forecast used in this analysis are presented and discussed in the EIA Service Report entitled, "Preliminary 1985, 1990, and 1995 Energy Forecasts for the Annual Report to Congress, 1979," April 1980. Documentation of the MEFS model structure can be found in:

"The Integrating Model of the Project Independence Evaluation System," Volumes I-VI, Energy Information Administration, February 1979;

"Revisions to the Midterm Energy Market Model Relating to Natural Gas Regulation, Advanced Technologies, Coal Demand and Dynamics," Energy Information Administration, April 1979: and;

"Documentation of EIA's Industrial Boiler Fuel Model," Logistics Management Institute, January 1980.

While most of the calculations appear in the body of the Analysis Report, the exact source of the data and some additional calculations are missing. Table A-1 presents the source of all the data series used in the analysis including the table and MEFS run number for reference. In addition, certain conversions and other critical notes are also presented. Table notes A and B present the calculation of the coal severance tax and black lung tax along with references for the data used in these calculations.

Table A-1. Data Sources

Data Series	Source	MEFS Run Number	Notes
Marginal Fuel Prices	Table 39, MEFS Model Report	1985 - A3UB111 H 1990 - A3UC111 H 1995 - A3UD111 H	
Import Premium	Policy & Evaluation	N/A	Converted from \$'s/BBL to \$'s/Btu with a conversion factor of .1724 (March 1980 Monthly Energy Review). \$78 to \$79 conversion factor = 1.089.
Tax Adjustment (excluding coal)	Difference between MEFS base case Table 39 and MEFS no oil and gas tax and subsidy case.	MEFS Base 1985-A3TB113M 1990-A3TC111M no oil/gas tax 1985-A3TB323M 1990-A3TC323M	Since the 1995 323M run will not be made the 1990 tax adjustments are assumed to hold for 1995.
Coal tax adjustment	December 3, 1979 memo from Bill Meroney, Synergic Resources Corporation to Mary Paul for severance taxes.	N/A	For calculation of severance taxes, see calculation note A for black lung tax, see calculation note B.
Table Increased costs of coal, distillate, gas.	See Siler's memo to record.	N/A	
Total Generation	MEFS Table 20	Same marginal prices note.	

Calculation Note A: Coal Severance Taxes

DOE Regions	State	Tax (%)
New England	N/A	0
N.Y./N.J.	N/A	0
Mid-Atlantic	West Virginia	3.85%
South Atlantic	Kentucky	4.1%
Midwest ^a	N/A	0
Southwest ^a	N/A	0
Central	N/A	0
North-Central	Wyoming	13.57%
West	N/A	0
Northwest	N/A	0

^aSince severance tax data is only available on a state-by-state basis, regional taxes had to be computed. These taxes were determined by attributing the regional tax to a specific State by examining all of the states in a particular region and choosing as representative a state with relatively high coal production in the particular region. This method would tend to over-estimate the impact of the tax, but since the tax is assumed to remain in effect through 1995 and no additional taxes are assumed to be imposed, this method seems preferable. The severance tax data is from the source noted in the data source table and the state-level coal-production data used to determine the dominate State comes from 1977 Keystone Coal Industry Manual, McGraw-Hill, 1977.

Calculation Note B: Black Lung Tax^a

Year	Underground ^b	Production Surface ^b	Nominal Weighted Tax	Real (1979 \$'s) Weighted Tax	GNP Deflator ^c
1985	515.4	613.5	\$0.37	\$0.23	1.60
1990	746.7	606.4	\$0.39	\$0.18	2.20
1995	914.6	803.0	\$0.39	\$0.14	2.86

^aThe black lung tax is a \$0.25 per ton tax on surface-mined coal and \$0.50 per ton tax on underground-mined coal. To compute the average tax on all coal, a weighted average is taken where the weights are the surface and underground coal production figures. The production figures are taken from the MEFS output report, Table 15. The MEFS run numbers are identical to those noted under the marginal fuel price data source entry.

^bThe real weighted tax is computed by dividing the nominal tax by the GNP deflator.

^cSource: April 3, 1980, memorandum entitled, "New Inflation Indices for ARC79," by David McNicol, Energy Information Administration.

The only additional arithmetic calculations not included in the subject report are the work sheets used to calculate the intangible drilling allowances, differential royalty fees and the electricity price calculations. These calculations are detailed in a memorandum to the record entitled, "Electric Utility and Tax Calculations Underlying the BEPS Analysis," by Ann Siler. Additional calculations and notes were kept in a logbook maintained by Mark Rodekohr.

B

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