State Energy Price System

Volume II Data Base Development

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June 1982

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1. INTRODUCTION

This is Volume II of a two-volume report on the State Energy Price System (STEPS) developed by the Pacific Northwest Laboratory under contract to the Energy Information Administration, Office of Energy Markets and End Use. The primary objective of the effort was to utilize existing data sources and previous analyses of state-level energy prices to develop new and consistent energy price series by fuel type and end-use sector for each of the 50 states and the District of Columbia for the period 1970 through 1980.

Volume I of this report, intended as a reference for users of the data base, provides an overview and the technical documentation of the resulting energy price data base. This volume is intended for use by those who are interested in the details of the data base development process, including EIA staff who may be charged with annual updating of the data base. The purpose of Volume II is to document the entire data development process in sufficient detail to permit critical assessment of the data base. However, since a methodological discussion is included in Chapter 3 of Volume I, it is not repeated here.

The data base development process was conducted in a fuel-by-fuel fashion, following the general sequence of electricity, natural gas, coal, distillate fuel, motor gasoline, diesel, kerosene, jet fuel, residual fuel, and liquefied petroleum gas. For each of the fuels, a detailed data source review was conducted, which included a preliminary screening against criteria set up for this purpose. After this first screening, the data sources that met most of the review criteria were evaluated in more detail. If there was one data source which met all the criteria, that data source was recommended for use, with minimal change or imputation. If there were substantial gaps in the available data series, then alternative imputation procedures were developed and compared, and recommendations were formulated. This entire procedure was then documented in a draft working paper for review and discussion. To the extent reasonable and practical, comments from the formal EIA reviews were then incorporated into the final recommendations and the data base was developed.

The implementation generally involved the derivation of empirical linking and imputation equations, the computation of imputed data using the empirically derived equations, and the preparation and verification of the data tapes. For a description of the general approach and methodology, the reader is referred to Section 3.2 in Volume I of this report. The detailed fuel-by-fuel descriptions of the data base reviews, the consideration of imputation procedures, the empirical derivations of the equations, and the imputations actually used are explained in the rest of this volume (Chapter 2 through Chapter 10).

1.1 DATA BASE REVIEW CRITERIA^(a)

At the beginning of the data base development process, a common set of criteria was established to screen available data sources for possible use in the STEPS. Since these criteria underlie the data base reviews described in each of the next nine chapters, they are listed and explained below:

1. The price series must be developed by primary data collection. It is at the level of actual data collection and aggregation that the reliability of the data can be assessed. This criterion eliminated data bases that were simply a compilation or re-presentation of data from other sources.
2. The data must be published and be available from 1970, and must be collected on a consistent basis at fixed time intervals of one year or less. Since the EIA must, by law, make public any data which it uses,^(b) the STEPS cannot be proprietary in any sense. Consistency in the method and timing of data collection is desired because the EIA data base development must be on a continuing basis. Collection intervals of one year or less are necessary to allow for calculation of annual prices. This criterion ruled out the use of data which do not form a comprehensive and consistent series, such as the data collected by individual state agencies.

(a) This subsection is the same as the material contained in Subsection 3.2.2 in Chapter 3 of Volume I.

(b) Department of Energy Organization Act, P.L. 95-91, Section 205, g.

3. The data must be reported at the company, utility, city, or state level. This criterion was designed to identify data bases that contain state-level price estimates and data bases from which state-level price estimates can be generated. Sources whose price data have a lowest aggregation level greater than the state level were, therefore, generally excluded from possible use in the data development process.^(a)
4. The data must cover the entire United States. This criterion was included in the review both to minimize the number of states for which prices had to be imputed, and to exclude data sources in which the accuracy of the data varied considerably across states. It was recognized, however, that some gaps in coverage of Alaska, Hawaii, and the District of Columbia would be unavoidable.
5. The data must be reported by end-use sector. This criterion screened out those data bases that aggregate all end-use consumption and those that categorize consumption by source or type of supply, rather than by demand sector. As noted, the five end-use sectors considered in this study area the residential, commercial, industrial, transportation, and electric utility sectors. However, not all five sectors are required for each of the fuels considered.
6. Data collection and aggregation procedures must be documented by the source organization. In order to evaluate the accuracy of the data and its suitability for EIA purposes, factors such as sample design, product definitions, and price imputation methods had to be known. This criterion ruled out possible use of any data bases whose source organization refused to reveal the methodology used.
7. The data for a calendar year must be available before the end of the following calendar year. This was required because of the need to use the price series data in preparing the EIA's Annual Report to Congress and other documents that must be produced in a timely

(a) In the case of jet fuel (transportation sector), state-level data were not available, so regional data were used.

manner. The specific time requirements were such that data sources with more than a 10-month availability lag were generally excluded from possible use.

8. The data must permit calculation of volume-weighted cost per million Btu. This was required by the EIA. With this measure of energy price, the price data can be multiplied by consumption volume data to yield an estimate of total fuel expenditures. A price per million Btu consumed also ensures consistent measurement of end-use consumption across physical units that may vary in Btu content.^(a)

1.2 VOLUME II REPORT STRUCTURE

Chapters 2 through 10 document the development of the state-level price series for electricity, natural gas, coal, distillate fuel oil, gasoline, diesel, kerosene and jet fuel, residual fuel oil, and LPG respectively. In each chapter, the background section discusses the end-use sector and fuel definitions. This is followed by a detailed review of data sources and recommendations. To the extent that imputation procedures are needed for the specific fuel under consideration, they are also explained. A summary of the comments from the formal EIA review of each working paper is included at the end of each chapter. Appendix E provides additional information on the data source review forms. Appendix F provides a simple explanation of the regression analysis used in the report.

(a) It should be noted, however, that a state-level price per million Btu provides no indication of the range of prices in each state. Information about price ranges is important when consumer response to price change is being analyzed. Therefore, implementation off this criterion results in a data base that can only be used to generate very gross price response estimates for fuel consumption.

2. ELECTRICITY

Electricity is generated in conventional power plants fueled by oil, coal, and natural gas, and in power plants driven by hydropower, nuclear power, gas turbines, internal combustion engines, as well as by geothermal steam and by other energy sources. In 1979, total generation in the U.S. amounted to 2247 billion kilowatt-hours, of which conventional steam plants accounted for 75 percent, hydropower 12 percent, nuclear power 11 percent, and the other categories combined 2 percent.

Electricity is used in practically all sectors. The residential and commercial sectors use electricity for space heating and cooling, water heating, lighting, refrigeration, cooking, and operation of electronic and other electrical equipment and appliances. Industries use electricity for space and process heat, mechanical drive, and electrolytic and other processes. Transportation use of electricity typically involves railroads and railways which run electric trains. These four sectors generally purchase electricity from the electric utilities serving them, although some large industrial firms generate some or all of the electricity they use. Electric utilities, as business concerns, also use electricity for the usual lighting, heating, mechanical drive, and other purposes. However, the electricity they use is either generated from their own power plants or purchased at wholesale rates. For this reason, this study does not include the development of a separate electricity price series for the electric utility sector.

In 1979, the industrial sector was the largest end-use sector accounting for about 37 percent of total electricity consumption in the U.S. The residential sector was the second largest end-user with 30 percent, while the commercial sector was third with 21 percent. Governments, railways, street lighting, and "sales not elsewhere included," categories together accounted for only three percent. The other nine percent was accounted for by transmission and distribution losses, use by the electric utilities, and other system losses. (DOE 1980a, pp. 157 and 161.)

The electricity price measure included in the data base is based on the "average revenue per unit of sales" concept. It is expressed as "\$ per kilowatt-hour sold" in physical unit terms or "\$ per million Btu sold" in Btu

units. Because of the nature of the underlying data sources used in the derivation of these average price measures, there is some lack of precision in the definitions for commercial and industrial sectors.

As explained in Volume I, Chapter 3 of this report, the commercial sector is defined to include public utilities other than electric utilities, and public transportation (SIC 48, and 49 except 491 and part of 493), wholesale and retail sales (SIC 50-59), finance, insurance and real estate (SIC 60-67), services (SIC 70-89), and government (SIC 91-93). The industrial sector is defined to include agriculture (SIC 1-9), mining (SIC 10-14), construction (SIC 15-17), and manufacturing (SIC 20-39). The data on electricity kilowatt-hour sales and revenues, however, are generally collected according to the specific rate schedules in use by individual utilities.

Historical data on sales of electricity to businesses and industries are generally included in two categories: "small power and light" which require less than 1000 kilowatts of service and "large power and light" which requires more than 1000 kilowatts of service. There may be small manufacturing establishments which, by the definitions explained above, should be included in the industrial sector but are actually included in the "small power and light" category in the data because their electrical services are provided at less than 1000 kilowatts. Similarly, there may be large commercial businesses which, by the SIC classifications should be included in the commercial sector, but are actually included in the "large power and light" data category because their service demand is greater than 1000 kilowatts. In this study, we have followed the convention of equating the "small power and light" to the commercial sector, and the "large power and light" to the industrial sector. Moreover, included in the commercial sector price series are sales and revenue data for governments, street and highway lighting, and "sales not elsewhere included."

Another lack of precision or consistency in the definitions also occurs in the transportation sector. As mentioned elsewhere, the household use of automobiles has been included as part of the transportation sector. This has allowed attributing all residential transportation use of motor gasoline to the transportation sector. To be consistent, household use of electric vehicles should also be attributed to the transportation sector. However,

current data do not allow separation of the electricity used in recharging the battery used in these vehicles. Since the present use of electric vehicles is quite limited, this has not been a significant issue. If the use of electric vehicles were to increase substantially in the future, including electric vehicle energy use in the residential sector may become a serious data deficiency.

2.1 DATA BASE REVIEW

A list of published sources of electricity prices or revenue and sales data was first compiled from: Ideamatics, Inc., Federal Energy Data System Analysis and Evaluation, 1978; American Gas Association, Energy Statistics: North American and World Sources, 1977; and a computer search of energy-related bibliographic data bases. Preliminary review of all of the published sources identified revealed that just nine (listed in Table 2.1) met or nearly met the review criteria discussed previously (see Section 1.1). Detailed information pertaining to the content and development of these nine data bases was collected and is included in Appendix E. Examination of the candidate sources revealed that only one fully meets all of the selection criteria, the Edison Electric Institute's Statistical Year Book of the Electric Utility Industry. The other data bases were deficient in one or more important respects (see Table 2.2). A comparison of the data sources is presented below, including a description of each data series and the procedures used to develop it.

The Edison Electric Institute's Statistical Year Book of the Electric Utility Industry, which is the most comprehensive data source for state-level electricity prices, is currently used for the state-level energy price series by the EIA. Edison Electric Institute publishes state-level revenues and sales data by sector, allowing calculation of volume-weighted average prices for each state. However, it is unclear whether or not average retail prices include state and local taxes. The sectoral breakdown is residential, commercial, industrial, street and highway lighting, other public authorities, interdepartmental, and railroads and railways. Some utilities report rural customers, which are allocated to the residential and commercial sectors by EEI.

TABLE 2.1. Candidate Sources of Electricity Price Data

<u>Organization</u>	<u>Publication</u>	<u>Form</u>
Energy Information Administration	<u>Statistics of Privately Owned Electric Utilities in the United States</u>	FPC-1
Energy Information Administration	<u>Statistics of Publicly Owned Electric Utilities in the United States</u>	ERA-412
Energy Information Administration	<u>Electric Power Statistics</u>	FERC-5
Edison Electric Institute	<u>Statistical Year Book of the Electric Utility Industry</u>	Uniform Statistical Report
Bureau of Labor Statistics	<u>Consumer Prices: Energy</u>	EIA-101
Bureau of Labor Statistics	<u>Producer Prices and Price Indexes</u>	EIA-101
Bureau of the Census	<u>Annual Survey of Manufactures</u>	MA-100
American Gas Association	<u>Gas Househeating Survey</u>	N.A.
Energy Information Administration	<u>Typical Electric Bills</u>	EIA-213

TABLE 2.2. Comparison of Candidate Electricity Price Data Bases

Characteristic	EIA/ FPC-1	EIA/ ERA-412	EIA/ FERC-5	EEI	BLS CPI	BLS PPI	Census
Adequate data for state level price estimates	-	-	-	+	-	-	-
Sectoral coverage:							
Residential	+	+	+	+	+	-	-
Commercial	+	+	+	+	-	+	-
Industrial	+	+	+	+	-	+	+
Transportation	+	-	-	+	-	-	-
Other	+	+	+	+	-	-	-
Timely availability of annual data	+	+	+	+	+	+	-
Minimal imputation of missing data	+	+	-	+	+	+	+

+: Yes or available
-: No or unavailable

This data is voluntarily reported to EEI annually on the Uniform Statistical Report, a data collection form which is also used by the American Gas Association. The public and private utilities reporting account for about 97% of total electric generation and involve 320 state operations of utilities. Data from a monthly survey of a subgroup of utilities is used in validation of the published data. Collection methods have changed very little over the past 20 years and the published data are generally available about 10 months after the end of the survey year.

The remaining eight candidate sources of electricity prices are primary data sources that display some but not all of the desired characteristics. The deficiencies of two of these data bases, Typical Electric Bills and Gas Househeating Survey, render them completely unusable. While both report prices at the city or utility level, corresponding measures of average consumption are

lacking. As a result, volume-weighted average prices cannot be calculated from the data.

Five of the remaining six candidate data sources cannot be used to calculate state prices because of problems in either sample design or aggregation level. Data for Consumer Prices: Energy and Producer Prices and Price Indexes are collected by the EIA on EIA Form 101, and cover residential, commercial, and industrial rates (40 kW and 500 kW demand). While the voluntary response to the survey has been high and the resulting data have been properly verified, the geographic coverage is deficient; the survey covers utilities in 85 SMSA representing only forty states. Since the published data are aggregated for Census Regions and most of the city data are not released, these data bases cannot easily be used even for validation of data from other sources.

Another data source with a sample that is inadequate for development of state price estimates is the EIA Electric Power Statistics collected on FERC Form 5. These data are collected from utilities with sales of over 100 million dollars and some smaller utilities in regions where data would otherwise be lacking. Approximately 83% of total industry sales is covered by this sample. To publish state-level sales estimates the reported kilowatt-hour data are expanded based on annual data from FERC Form 12. Revenue estimates are published by sector but not by state since the data set is incomplete and a means of augmenting it is not readily available.

Two other EIA data bases, taken together, come closer to being adequate for use in the price series: Statistics of Publicly Owned Utilities and Statistics of Privately Owned Utilities. These sources are based on mandatory annual submission of data from the largest utilities, over 700 of them. The sectoral coverage provided for the private utilities is similar to that in the Edison Electric Institute data. Coverage for the public utilities is less disaggregated but still adequate. Both bases, however, lack allocation of utility revenue and sales data to the state of operation. Private utility data are listed by the state from which most of the utility's revenues are drawn. Municipal utilities are listed by state but federal projects are not, and information is not readily available from other sources for use in allocating the end-use sales and revenues data to states. In contrast, when these same

utilities submit the same data to EEI, figures are broken out by state of operation.

The remaining candidate data source meets all of the required criteria except that it covers only the industrial sector. While it cannot be used for the price series, the Bureau of the Census' Annual Survey of Manufactures could be used in data validation. It is based on a probability sample of 70,000 manufacturing companies, from whom response is mandatory. The physical quantity and cost of purchased energy are reported by state and also by two-and three-digit SIC Code. In addition to the sampling design, computer and analytical checks for data consistency make this a high quality data base.

2.2 RECOMMENDATIONS

Of the candidate data sources, the EEI Statistical Year Book is the only one which fully meets all of the selection criteria. This data base provides state-level revenue and sales information for all of the major end-use sectors and the data is reported by utilities representing over 97% of total generation. Therefore, it is recommended that data from the EEI Statistical Year Book continue to be used for the electricity price series, as was done in State Energy Fuel Prices by Major Economic Sector From 1960 Through 1977. (DOE, 1979c). However, the sectoral aggregation of this data should be changed so that the electricity use reported by EEI for "railroads and railways" is attributed to the transportation sector. No changes are required in the annual updating procedures other than that associated with the change in sector aggregation.

2.3 SUMMARY OF AGENCY COMMENTS

Formal EIA review of the working paper on electricity price series concurred with the use of EEI data and on the addition of the transportation sector price series. Two points were noted specifically:

1. Although the selection of a non-EIA data source for electricity price series is unusual, it is justified by the consistency, large sample coverage, and adequate sector detail of the EEI data, as well as the lack of state-level details in the EIA data.

Response: This is a good summary of the reason for using EEI data in this data base. A fuller citation of this comment has been incorporated into the findings of this project. (See Volume I, Chapter 2 of this report).

2. It was suggested that consideration be given to including "street and highway lighting" category, (presently included in the enlarged commercial sector), in the transportation sector.

Response: No change has been made in the sectoral classification because the proposed treatment of this particular category is consistent with the treatment by the EIA in State Energy Data System and Annual Report to Congress.

3. NATURAL GAS

Natural gas refers to the gaseous fuel delivered to end users through the interstate pipeline systems and the gas utility distribution systems. It is primarily a mixture of hydrocarbon compounds, with small quantities of various non-hydrocarbons existing in the gaseous phase. For the purpose of this study, natural gas includes fuels derived from extraction of natural underground reservoirs (gas wells and oil wells), underground storage reservoirs, and production from synthetic processes.

The average heat content of the natural gas consumed by end-use sectors depends upon the exact mixture of the gas delivered in a specific year or in a specific state. From 1950 to 1980, the average heat content of natural gas delivered to all end-use sectors in the U.S. declined gradually by 1.4 percent from 1035 Btu to 1022 Btu per cubic foot (DOE 1980a, p. 230). An example of the geographic variation of the average Btu content of gas delivered is that, in 1979, state average Btu content varied from approximately 900 to 1075 Btu per cubic foot.

Natural gas is consumed in all five economic sectors considered in this study. Residential and commercial sectors use natural gas principally for space and water heating and for cooking. Industries use natural gas for process heat, space heat, and feedstock. The "lease and plant fuel" use of natural gas, which is included in industrial sector use, refers to the amount of natural gas used in lease operations as gas processing plant fuel and net used for gas lift. The transportation sector use of natural gas refers to compressor use of gas in the pipeline systems, generally termed "pipeline fuels" in the statistics. Electric utilities burn natural gas in gas turbines, combustion engines, and steam electric plants.

Nationally, the industrial sector has been the largest consuming sector of natural gas, accounting for 41 percent of consumption in 1979. The residential sector was the second largest end user in the same year with 25 percent of consumption. The electric utility, commercial, and transportation sectors accounted for, respectively, 17 percent, 14 percent, and 3 percent (DOE 1980a, p. 107).

There is some ambiguity in the data on commercial and industrial sectors. In the original data, sectors are classified according to gas utilities' rate schedules, rather than defined by Standard Industrial Classification codes. Small manufacturing establishments in SIC 20 through SIC 39, because of their small volume of gas use, are included in the commercial sector, rather than in the industrial sector. Conversely, there are also cases in which large commercial and institutional accounts, because of their large volume of gas consumption, are included in the industrial sector. This data problem is similar to that of electricity described in Chapter 2, although the problem probably occurs to a lesser extent.

3.1 DATA BASE REVIEW

Eight published sources of primary natural gas price data (see Table 3.1) were given an in-depth review for compatibility with the criteria described previously. The list of sources was compiled from the American Gas Association's (AGA) Energy Statistics: North American and World Sources, 1977; the Ideamatics' report, The Federal Energy Data System Analysis and Evaluation, 1978; a search of bibliographies of energy-related reports and publications; and interviews of individuals in the DOE and in the natural gas industry. An examination of the candidate sources revealed that only two fully meet all the selection criteria: Gas Facts and Natural Gas Production and Consumption: Annual. All of the other sources lacked several important characteristics (See Table 3.2). A comparison of the sources is presented below, including a description of each data series and the data collection procedures used.

The Natural Gas Production and Consumption: Annual (also called Natural Gas Annual), which is the most comprehensive government data source for natural gas prices and the one used in the existing state-level price series, is published annually by the EIA. The data is collected from about 1600 survey respondents, including gas producers, transmission companies, utilities, and all others who deliver natural gas for end use. Since 1960, the data have been voluntarily reported on Bureau of Mines Forms 1340-A and 1341-A. Beginning in 1981 (1980 statistics), reporting was made mandatory on Form EIA-176. Natural Gas Production and Consumption data for any calendar year is usually available in October of the following year. Consistent data have been published since 1968; a questionnaire change was made that year. As a result, comparison of

TABLE 3.1. Candidate Sources of Natural Gas Price Data

<u>Organization</u>	<u>Publication</u>	<u>Forms Used</u>
American Gas Association	<u>Gas Househeating Survey</u>	N.A.
American Gas Association	<u>Gas Facts</u>	Uniform Statistical Report
Energy Information Administration	<u>Natural Gas Production and Consumption: Annual</u>	EIA-176 (BOM 1340A and 1341A)
Bureau of Labor Statistics	<u>Consumer Prices: Energy</u>	N.A.
Bureau of Labor Statistics	<u>Producer Prices and Price Indexes</u>	N.A.
Census Bureau	<u>Annual Survey of Manufactures, Census of Manufactures</u>	MA-100 (MU)
Energy Information Administration	<u>Cost and Quality of Fuels for Electric Utility Plants</u>	FPC 423
Energy Information Administration	<u>Statistics of Interstate Natural Gas Pipeline Companies</u>	FERC 2 (formerly FPC 2)
Energy Information Administration	<u>Steam-Electric Plant Construction Cost and Annual Production Expenses</u>	FPC Form 1; ERA 412 (formerly FPC Form 1-M)

historical data can only be made with care. Form EIA-176 asks each reporting entity to indicate average Btu content per cubic foot, information not collected in the past.

The percentage of natural gas distributors responding to the survey and the market share they hold is believed by EIA staff to be nearly 100 percent. In the past, nonresponding companies were sent a second data request form, and if necessary, contacted by phone. Missing data were imputed using information collected in mandatory reports, such as FPC Form 2, "Annual Report of Natural

TABLE 3.2. Comparison of Natural Gas Price Data Bases

Characteristic	AGA Survey	AGA Gas Facts	EIA Natural Gas Annual	PPI	CPI	Bureau of Census	Cost & Quality	EIA Gas Pipelines
Adequate data for state level estimates	-	+	+	-	-	+	+	-
Sectoral coverage:								
Residential	+	+	+	-	+	-	-	+
Commercial	-	+	+	+	-	-	-	+
Industrial	-	+	+	+	-	+	-	+
Transportation	-	-	+	-	-	-	-	-
Electric Utility	-	+	+	-	-	-	+	-
Other	-	+	+	-	-	-	-	+
Timely availability of data	+	+	+	+	+	-	+	+
Minimal missing data	+	+	+	+	+	+	+	-
Btu content data	+	+	+(a)	-	-	-	+	-

+: Yes or available

-: No or unavailable

(a) Collection of Btu data beginning in 1981.

Gas Pipeline Companies," or EIA Form 50, "Alternate Fuel Demand Due to Natural Gas Curtailment."

Price per thousand cubic feet is now published in Natural Gas Production and Consumption, rather than just quantity (cu. ft.) and sales value as in previous years. Volume weighted average prices are given for every state for each of five sectors: residential, commercial, industrial, electric utility, and other consumers (particularly sales to municipalities and public authorities). Sectoral definitions are provided to respondents in the instructions accompanying the data collection form. Data for the utility sector has been collected on BOM Forms 1340-A and 1341-A (and will be collected on EIA Form 176) but is not published in Natural Gas Production and Consumption. To minimize discrepancies among different DOE publications, the utility data reported in Natural Gas Production and Consumption are taken from FPC Form 423, "Cost and Quality of Fuels for Electrical Utility Plants" and FERC Form 4, "Power Production, Fuel Consumption, and Installed Capacity Data". FPC Form 423 collects price and volume figures for plants with capacity greater than 25 megawatts while FERC Form 4 collects volume figures for all plants but no price data. Average state prices taken from FPC Form 423 are multiplied by state volume data taken from FERC Form 4 to obtain the value data published in Natural Gas Production and Consumption. As a result, the utility sector prices reported in Natural Gas Production and Consumption are exactly the same as those reported in Cost and Quality of Fuels for Electrical Utility Plants.

Gas Facts, an American Gas Association publication providing natural gas statistics since 1955, is the other data source that fully meets all of the selection criteria. At the beginning of each calendar year, a survey form is mailed to all 320 members of the AGA. This form, the "Uniform Statistical Report" is also used for data collection by the Edison Electric Institute. Survey responses are voluntary; however, most AGA members do respond, so that participation in the survey represents about 97 percent of total gas utility industry sales.

Average natural gas prices by state are given in dollars per million Btu for total sales and for four classes of service: Residential, commercial, industrial, and other. Utilities may use their own sectoral definitions (which

must be briefly described in the survey response) or can use definitions recommended by the AGA. According to the AGA definition, the residential sector includes service to single family residences. The commercial sector is defined as service to apartment buildings and customers who are engaged in wholesale or retail trade. The industrial sector is defined as sales to those engaged primarily in creating or changing raw or unfinished materials into another form or product. The sector known as "other" is defined as sales of gas to municipalities or public authorities. Since 1976, data for the commercial sector have included gas used for electrical generation (prior to 1976, this use was included in "other"). Average prices of gas used for electrical generation are also reported separately. Gas Facts does not disaggregate data for a transportation sector.

The data are usually reported to AGA in the form of sales in therms and revenue in dollars. Revenue is then divided by sales to calculate price in dollars per million Btu. Some companies, however, do not report sales in therms, but rather, in cubic feet sold. If these companies also report average Btu per cubic foot of gas, that figure is used to calculate therms sold; if not, the industry-wide, average Btu content per cubic foot is used.

Gas Facts is published approximately six months after the end of each calendar year. There has been no significant change in the data collection method since 1955, and the only change in reporting involves the sectoral allocation of gas used for electrical generation. Gas Facts staff recheck any anomalous values by contacting the reporting utility. Missing data due to nonreporting companies (usually 3 percent of total gas utility industry sales in any given year) are estimated based on recent historical experience so that statewide and nationwide averages can be published.

The remaining six candidate sources of natural gas prices are primary sources of price data that display some but not all of the desired characteristics. The least acceptable of these sources for the development of state-level price estimates is the Producer Prices and Price Indexes monthly report prepared by the Bureau of Labor Statistics. Only three categories of natural gas prices are published in the Producer Price Index: Interstate, intrastate, and imported gas. Prices are regional or national averages and pertain only to the industrial sector. Btu content is not given.

The other Bureau of Labor Statistics publication reviewed, Consumer Prices: Energy, is a monthly report of three types of residential (defined as single family homes) price data: Average cost at 40 therms, at 500 therms, and volume-weighted average cost per therm. All Consumer Price Index data include taxes and fees. Data are collected by field agents from every natural gas utility serving residents within 85 SMSAs. Although reporting is voluntary, there are rarely any missing data. Data are spot checked and anomalous figures are rechecked with the reporting utility. Consistent Consumer Price Index data are available back to 1970. The main change in collection methods since then was a sample size increase in 1978 from 56 to 85 SMSAs. The Bureau of Labor Statistics usually releases Consumer Prices: Energy within a month after the end of the survey month.

Despite the relative accuracy of Consumer Price Index data, there is a serious drawback in that the sample used does not cover all regions equally well and does not include all states. Data is collected for 85 SMSA's in forty states, but prices are only reported for 28 cities, four national regions, and various classes of city sizes within each region. Consequently, the CPI cannot be used to estimate prices at the state level.

Statistics of Interstate Natural Gas Pipeline Companies is an EIA report of Class A and B gas pipeline company annual sales and revenue data. Average company prices per million cubic feet are listed for five sectors (residential, small and large commercial, small and large industrial, sales to other public authorities, and interdepartmental). About 83 companies are required to participate in the mail survey by completing FERC Form 2 (formerly FPC 2). Data submitted by the companies are checked for anomalous figures and onsite audits are occasionally made. Information in Statistics is not aggregated by state, nor is state-by-state data available for the reporting companies. Furthermore, collected statistics do not represent the entire industry, since only the largest pipeline companies are included. For these reasons, this data source is inadequate for development of state-level prices.

Another data base that does not permit calculation of volume-weighted, state-level prices is an American Gas Association publication, the Gas Househeating Survey. Data contained in the Gas Househeating Survey pertain specifically to the residential gas market and are collected, analyzed, and

prepared for annual publication independently of Gas Facts. About 215 survey forms are mailed to AGA members and completed replies number about 155. It is the AGA's experience that relatively large utilities are more likely to respond; consequently, utility companies representing about 90 percent of the nation's residential gas customers respond to the survey each year. Prices published are those charged by utilities as of December 31 of the survey year. Prices are presented in dollars per million Btu and are the rate charged for househeating gas use only; baseload prices and taxes are excluded. Appendix 2 of the AGA Survey defines the excluded baseload consumption as all domestic use of gas (e.g., ranges, water heaters, and clothes dryers) except househeating and air conditioning.

Data reported by the utilities are checked by the AGA staff. An expected data range is determined using historical data and anticipated growth rates. If reported values do not fall within the expected range, they are rechecked with the reporting utility. Missing data are pursued only when the utility involved is a relatively large supplier of residential natural gas. The Survey, which is published approximately 9 months after the end of the survey year, was released for the 32nd consecutive year in 1980. Collection techniques have not changed significantly since publication began.

The price data listed in the Survey are reported for each utility and for major cities served in every state. Thus, each utility reports a separate price for each state in which it supplies customers. Nine regional average prices are also listed. The major deficiency of the Survey is its lack of quantity data. Since sales quantity information is not collected, the regional average prices are simple means and volume-weighted state prices cannot be calculated from this data.

The remaining two data bases cover only one end-use sector, yet can provide adequate data for state-level price estimates and have minimal problems with missing data. They can be used to cross-check or supplement data for the sector they cover. A good source of industrial sector natural gas prices is the Bureau of the Census' Annual Survey of Manufactures (also Census of Manufactures) containing data on fuels and electric energy consumed. The survey sample of 70,000 companies and firms is chosen from a universe of 300,000 and the response rate is over 90 percent. Form MA-100 (MU), mailed to

respondents in January, is used to collect data. Cost and quantity figures are grouped by state and are presented for each 3-digit SIC industry.

Cost is defined by the Bureau of the Census as the delivered price of natural gas. Incoming data is first computer-edited for consistency with previously collected data and then validated if any inconsistencies appear. Approximately a one-year lag to publication is planned; however, that schedule has been disrupted by both the 1972 and 1977 Census of Manufactures. Consequently, the 1978 Annual Survey was released in 1981. By 1982 the Bureau of the Census hopes to once again reduce the lag to one year.

Utility sector data are available from the EIA Cost and Quality of Fuels for Electric Utility Plants, which presents natural gas prices collected from all electric utility plants with capacity greater than 25 megawatts. Approximately 280 utilities are required to report fuel costs on FPC Form 423, which is mailed monthly. A summary of Cost and Quality is published annually. Prices listed in Cost and Quality are in cents per million Btu and dollars per million cubic feet, reported by utility, by state, and by region. Quantities purchased and average Btu content are also specified. All data on natural gas includes small quantities of blast furnace gas, coke oven gas, and refinery gas. It appears that lumping together all these fuel types under "natural gas" has little effect on the price estimates; companies receiving gaseous fuels other than natural gas between 1975 and 1978 numbered only 6 out of 279 reporting utilities. Data collected for Cost and Quality are checked by telephone and missing data are imputed using averages of previously reported values. Price data are consistent back to 1973. Since 1978, the EIA has managed only a five-month lag to annual publication. The utility sector data from Cost and Quality are also used in the EIA's Natural Gas Annual.

The EIA publishes another source of utility sector natural gas prices called Steam Electric Plant Construction Cost and Annual Production Expenses. This publication covers a slightly different sample than Cost and Quality and is compiled by a different office within the EIA. FPC Form 1 and ERA Form 412 (formerly FPC Form 1-M) are used to collect the price data appearing in Steam-Electric Plant. Prices are given in dollars per million Btu and per cubic foot. The primary difference, other than the criteria for required reporting, between the price series published in Cost and Quality and that published in

Steam-Electric Plant is that the former provides volume-weighted state-average prices while prices from the latter cannot be aggregated to the state level. Data collected for Steam-Electric Plant are reviewed for consistency with historic figures and missing data are not imputed. Consistent gas price figures are available since 1938. There is a nine month lag to annual publication.

3.2 RECOMMENDATIONS

It is recommended that use of Natural Gas Production and Consumption as the source of the price series data be continued. Comparison of the two sources that most fully meet the selection criteria indicated that use of Natural Gas Production and Consumption is preferable to use of the AGA's Gas Facts, primarily because the former is under EIA control. Natural Gas Production and Consumption covers all of the desired end-use sectors, has minimal missing data problems, is available within the desired time frame, and provides adequate data for the computation of state-level price estimates.

It is recommended that data from Cost and Quality of Fuels for Electric Utility Plants be used as the source of utility data for the price series. This will result in relatively complete data for the total end-use consumption of natural gas. It is also recommended that the transportation sector prices be developed exclusively from the "pipeline fuel" data.

It is further recommended that the method of calculating gas price per Btu be changed. In the past, a national average Btu content estimate has been used to compute price per Btu figures. Since state average Btu content varies from approximately 900 to 1075 Btu per cubic foot, use of a separate Btu content estimate for each state is preferable to use of the national average. The EIA has not previously collected Btu content estimates; however, state-level Btu content estimates are published annually in AGA's Gas Facts. Beginning in 1981, average Btu content will be collected on EIA Form 176; the future computation and use of a state-level, volume-weighted Btu content estimates from the EIA-176 data should be considered. The improvement in accuracy resulting from the use of state rather than national Btu content values will assure that the gas price series based on Natural Gas Production and Consumption is of the highest quality possible given current data limitations.

3.3 SUMMARY OF AGENCY COMMENTS

Formal EIA review generally concurred with the use of Natural Gas Production and Consumption, Annual and Cost and Quality of Fuels data in the natural gas price series. Several other points were also noted:

1. In the draft working paper, it was recommended that no transportation sector price series be derived for natural gas. Several EIA offices commented that natural gas consumed in the transportation of natural gas through the pipelines is a legitimate end-use of the fuel and, therefore, should be represented by a separate category.

Response: As shown in Section 3.2 above and throughout Volume I of this report, a transportation sector price series has been developed for inclusion in the data base.

2. One EIA office did not concur with the recommendation of the use of state-specific Btu conversion factors from American Gas Association data in the computation of Btu unit prices at this time. Instead, it recommended delaying the action until such time when adequate EIA data of similar nature become available.

Response: We conducted a limited analysis of the impacts of using the AGA data on state-specific Btu conversion factors. The result showed that there were substantial gains in the accuracy of the price series when the AGA data were used. Therefore, the Btu unit prices have been calculated using the AGA's state-specific Btu values. When the EIA conversion factors become available for use, a conversion may be needed if such new EIA data contain data for earlier years. If the new EIA conversion factors are for current and future years only, the AGA numbers would still have to be used for the historical period.

3. Another EIA office requested that the natural gas price series be disaggregated by stage of production, in addition to the disaggregation by state.

Response: The task requested is beyond the scope of the current efforts by the PNL for the EIA.

4. COAL

Coal is a naturally occurring fuel that varies substantially by heat, sulfur, and ash content. For example, the heat content of coal ranges from as low as 6000 Btu per pound to over 15,000 Btu per pound. Similarly, the sulfur content of coal is generally classified as low (less than 1 percent), medium (1-3 percent), or high (more than 3 percent). (U.S. Geological Survey, 1974, p.81).

Because of variations in the important characteristics of the fuel, a ranking system has been developed to classify coal according to Btu value, agglomerating characteristics, and percentage of fixed carbon and volatile matter. Table 4.1 shows the standard categories used in the classification system. The relative levels of the critical characteristics for each category are shown in Figure 4.1. Most of the price and quantity data for coal, whether production (mine-mouth) or consumption oriented, are reported for the four major coal classifications or ranks: bituminous, subbituminous, lignite, and anthracite.

The EIA has given the following descriptions for these four coal types (DOE 1980a, pp. 217-223):

Bituminous Coal: A coal that is high in carbonaceous matter, having a volatility greater than anthracite and a calorific value greater than lignite. Often referred to in the United States as soft coal.

Subbituminous Coal: Black lignite or lignite coal rank intermediate between lignite and bituminous coal. Used almost exclusively for electric power generation.

Lignite: A brownish-black coal of low rank with high inherent moisture and volatile matter. It is also referred to as brown coal, and is used almost exclusively for electric power generation.

Anthracite: A hard, black, lustrous coal containing a high percentage of fixed carbon and a low percentage of volatile matter. It is often referred to as hard coal. It includes meta-anthracite and semi-anthracite.

TABLE 4.1. Classification of Coals by Rank^(a)

Class	Group	Fixed Carbon Limits %		Volatile Matter Limits %		Calorific Value Limits, Btu/lb		Agglomerating Character
		(Dry, Mineral- Matter-Free Basis)		(Dry, Mineral- Matter-Free Basis)		(Moist, ^(b) Mineral-Matter- Free Basis)		
		Equal or Greater Than	Less Than	Greater Than	Equal or Less Than	Equal or Greater Than	Less Than	
I. Anthracitic	1. Meta-Anthracite	98	--	--	2	--	--	Nonagglomerating
	2. Anthracite	92	98	2	8	--	--	
	3. Semianthracite(c)	86	92	8	14	--	--	
II. Bituminous	1. Low volatile bituminous coal	78	86	14	22	--	--	Commonly agglomerating(e)
	2. Medium volatile bituminous coal	69	78	22	31	--	--	
	3. High volatile A bituminous coal	--	69	31		14,000(d)	--	
	4. High volatile B bituminous coal	--	--	--		13,000(d)	14,000	
	5. High volatile C bituminous coal	--	--	--		11,500(e)	13,000	
						10,500(e)	11,500	Agglomerating
III. Subbituminous	1. Subbituminous A coal	--	--	--		10,500	11,500	Nonagglomerating
	2. Subbituminous B coal	--	--	--		9,500	10,500	
	3. Subbituminous C coal	--	--	--		8,300	9,500	
IV. Lignitic	1. Lignite A	--	--	--		6,300	8,300	
	2. Lignite B	--	--	--		--	6,300	

(a) This classification does not include a few coals, principally non-banded varieties, which have unusual physical and chemical properties and which come within the limits of fixed carbon or calorific value of the high-volatile bituminous and subbituminous ranks. All of these coals either contain less than 48% dry, mineral-matter-free fixed carbon or have more than 15,500 moist, mineral-matter-free British thermal units per pound.

(b) Moist refers to coal containing its natural inherent moisture but not including visible water on the surface of the coal.

(c) If agglomerating, classify in low-volatile group of the bituminous class.

(d) Coals having 60% or more fixed carbon on the dry, mineral-matter-free basis shall be classified according to fixed carbon, regardless of calorific value.

(e) It is recognized that there may be nonagglomerating varieties in these groups of the bituminous class, and there are notable exceptions in high volatile C bituminous group.

Source: American Society for Testing and Materials, 1974. "Standard Specifications for Classification of Coal by Rank." ASTM Designation D 388-66.

FIGURE 4.1. Classification of Coal by Physical Characteristics

Source: U.S. Department of the Interior, Bureau of Land Management. 1974. Draft Programmatic Environmental Statement, Proposed Federal Coal Leasing in the United States of America. Vol. I, Int DES 74. U.S. Government Printing Office, Washington, D. C., p. I-42.

In addition to this classification system, coals are generally differentiated into the categories of steam coal and metallurgical coal, depending on physical characteristics of the coal and its end use. Whether it is classified as bituminous or anthracite, metallurgical coal is characterized by distinctively low sulfur, ash, and phosphorus content. It has historically constituted a separate product market and its price has tended to be much higher than the price per ton of steam coal. Development of technology for the blending of coal has led to some substitution of steam and metallurgical coals across market lines in recent years (Charles River Associates 1980, pp 3.5, 3.6), but the price difference between these coals persists. Although the possibility of combining data for metallurgical and steam coal to develop one average coal price for the industrial sector was explored, it was concluded that such an average price would represent neither coal market.

Coal is used predominantly by the electric utility and industrial sectors. Electric utilities use coal as boiler fuel to raise steam for generating electricity. In 1979, this sector accounted for 78 percent of total U.S. coal consumption. The industrial sector uses coal for metallurgical coke production and non-metallurgical applications. Metallurgical use accounted for 11 percent of 1979 total U.S. consumption. All other industrial uses of coal amounted to 10 percent of the total. Transportation, residential, and commercial sectors combined accounted for only 1 percent of total use in the same year. The trend in the relative distribution of coal use by the economic sector over the last 28 years is shown in Figure 4.2

Prices for coal are generally reported as "contract" or "spot" prices, depending on whether they are determined by long-term contracts or by the open market. Most utilities purchase a major portion of their required coal supply from mining companies through long-term contracts for specified quantities and qualities of coal. In long-term contracts, prices are generally fixed by a base price to which a cost escalation formula is applied. Some larger users of both steam and metallurgical coals have stabilized the coal prices and supply conditions to some extent by acquiring "captive" mines (Ideamatics 1981).

In contrast, spot markets absorb the fluctuations in coal supply and demand conditions. As a result, spot prices are relatively volatile, although they follow the same long-run trend as contract prices. Purchases made in the spot market may be one-time, quantity-specific purchases, or they may be

FIGURE 4.2. U.S. Coal Consumption, 1960-1978, by Sector^(a)

(a) The transportation sector is not included because it accounts for an insignificant fraction of total coal consumption (less than 1% in 1960).

Source: DOE 1980e.

contracts of up to a year in duration. Utilities, manufacturing firms, and coal retailers all purchase some portion of their coal consumption in the spot market (Ideamatics 1981).

4.1 DATA BASE REVIEW

Eleven published sources of primary coal price data were reviewed in detail. The list of sources was compiled from the American Gas Association's (AGA) Energy Statistics: North America and World Sources, 1977; the Ideamatics' report, The Federal Energy Data System Analysis and Evaluation, 1978; bibliographic searches of energy-related reports and publications; and interviews with individuals in the DOE and editors of coal-industry journals. An examination of the candidate sources revealed that no single data base provided sufficient data to establish a state-level price series for all sectors. A comparison of the sources is presented below, including a description of each data series, the sectors it covers, and the data collection procedures used.

Since the purpose of this review is to make recommendations concerning the data to be used in a state-level price data base containing costs of end-use consumption, only sources that report delivered coal prices were reviewed in detail. Sources such as Coal Outlook, that report only f.o.b. mine mouth prices or secondary delivered coal price data, were eliminated from consideration. The various coal price data sources were evaluated with regard to their suitability for development of the coal price series, aggregating spot and contract prices into a volume-weighted average price per million Btu.

Five of the eleven candidate coal data sources were unsuitable for EIA use because they failed to meet most of the evaluation criteria. Coal Week and Black Diamond, which are coal industry publications, collect primary coal price data but do not provide data based on large enough samples for development of a state-level coal price series. In addition, figures published by Coal Week are not based on objective, systematic data collection and aggregation procedures. Another data source with a sample size that is inadequate for development of state-level price estimates is published by the West Virginia Public Service Commission. Data are collected on coal purchases by utilities serving only West Virginia electricity consumers. These data are published in a McGraw-Hill, Inc., newsletter entitled Fuel Price Analysis. Two candidate data sources that have discontinued publication of coal prices are the Bureau of Labor Statistics' Consumer Prices: Energy and the AGA's Gas Househeating

Survey. Both publications have stopped reporting residential sector coal prices due to the relatively insignificant amount of coal now used by that sector. The Gas Househeating Survey was reviewed in detail, however.

Elimination of the most seriously deficient data bases left seven for detailed evaluation. These data bases are listed in Table 4.2 by organization and the publication in which the data appear. All of these candidate data sources originated from federal agencies. Table 4.3 indicates some of the major characteristics of these data sources. Data are virtually confined to the industrial and utility sectors and reporting of price per million Btu occurs for the utility sector alone. The coal ranks and price categories for which data are reported are listed at the bottom of Table 4.3.

TABLE 4.2 Candidate Sources of Coal Price Data

<u>Organization</u>	<u>Publication</u>	<u>Forms Used</u>
Energy Information Administration	<u>Cost and Quality of Fuels for Electric Utility Plants</u>	FPC-423
Energy Information Administration	<u>Steam-Electric Plant Construction Cost and Annual Production Expenses</u>	FPC-1; ERA-412 (formerly FPC-1M)
Energy Information Administration	"Coal Consumption Report-Manufacturing Plants"	EIA-3 ^(a)
Bureau of the Census	<u>Annual Survey of Manufactures: Fuels and Electric Energy Consumed</u>	MA-100 (MU)
Energy Information Administration	<u>Coke and Coal Chemicals (Annual and Monthly - now Quarterly)</u>	EIA-5 and 5-A (formerly BOM Form 6-1370-A)
Bureau of Labor Statistics	<u>Producer Prices and Price Indexes</u>	N.A.
American Gas Association	<u>Gas Househeating Survey</u>	N.A.

(a) Unpublished until early 1982

N.A. - Not Available

TABLE 4.3. Comparison of Candidate Coal Price Data Bases

Characteristic	FPC 423	FPC 1/ ERA 412	EIA 3	BLS ^(a) PPI	EIA 5/5A	ASM	AGA
Adequate Data for State-Level Price Estimates	+	+	+	-	+	+	+
Sectoral Coverage:							
Residential	-	-	-	-	-	-	+
Commercial	-	-	-	-	-	-	-
Industrial	-	-	+	+	-	+	-
Utility	+	+	-	+	-	-	-
Transportation	-	-	-	-	-	-	-
Other (Metallurgical)	-	-	-	+	+	-	-
Timely Availability of Annual Data	+	+	+	+	+	-	+
Minimal Missing Data	+	+	+	+	+	+	-
Btu Content Data	+	+	-	-	-	-	+
Price Data by Coal Rank							
Bituminous	-	-	+	+	+	-	-
Subbituminous	-	-	+	-	-	-	-
Lignite	-	-	+	-	-	-	-
Anthracite	-	-	+	+	+	-	-

+ = Yes or Available
- = No or Unavailable

(a) Coal prices are reported by coal types and sizes generally used in the utility, industrial, and retail sectors.

The most comprehensive coal price data set for any end-use sector is found in the EIA's Cost and Quality of Fuels for Electric Utility Plants, which collects coal prices paid by all electric utility plants with capacity greater than 25 megawatts. Approximately 280 utilities are required to report fuel costs on FPC Form 423, which is mailed to DOE by the utilities monthly. Cost and Quality data are published monthly and a summary is published annually. Prices listed in Cost and Quality are in cents per million Btu for contract purchases, spot purchases, and a volume-weighted average of all coal

purchases. Each of these prices is reported both by generating plant and by state. Data collected for Cost and Quality are checked by telephone and there is no imputation of missing data. Price data are consistent back to 1972. Since 1978, the EIA has managed to publish the annual data within three to five months after the end of the year.

The EIA publishes another source of utility sector coal prices called Steam-Electric Plant Construction Cost and Annual Production Expenses. This publication covers the same sample as Cost and Quality (all plants with capacity greater than 25 megawatts) but is compiled by a different office within the EIA using different collection forms. FPC Form 1 and ERA-412 (formerly FPC Form 1-M) are used to collect the price data appearing in Steam-Electric Plant. Prices are given in dollars per million Btu for delivered coal. The primary difference, other than the criteria for required reporting, between the price series published in Cost and Quality and that published in Steam-Electric Plant is that the former provides volume-weighted state-average prices while the latter does not aggregate prices to the state level. Data collected for Steam-Electric Plant are reviewed for consistency with historic figures and missing data are not imputed. Consistent coal price figures are available since 1938. There is a nine-month lag to annual publication.

Industrial sector coal prices are available from three candidate sources. Two of these sources cover manufacturing uses while the third source covers coal use for coke and coal chemical production. The first data set is collected by the EIA on EIA-3 entitled "Quarterly Coal Consumption Report-Manufacturing Plants." EIA-3 is now mailed on a quarterly basis to all manufacturers within Standard Industrial Classification (SIC) categories 20 to 39. All manufacturers are required by law to submit a completed EIA-3; however, the EIA actively pursues responses only from firms that consume more than 200 tons of coal annually. The current sample size of about 1000 firms has been stable for 4 years, but due to increases in sample size, prices for years prior to 1978 are not strictly comparable to those of recent years. There is no imputation of missing data. Total cost and quantity figures are collected so that state-level price per ton can be calculated. Btu data are not collected, but since coal rank information is, price per million can be estimated. Because disclosure problems exist where three or less plants contribute to state totals, prices for some states are actually estimates across two or more states. As of 1981, the state data were not being published.

The second candidate source of industrial sector coal prices is the Bureau of the Census' Annual Survey of Manufactures and Census of Manufactures. The survey sample of 70,000 companies and firms is drawn from a universe of 300,000 firms and the response rate is over 90 percent. Form MA-100 (MU), mailed to respondents in January, is used to collect data. Coal cost and quantity figures are grouped by state and are presented for each 3-digit SIC industry. Cost is defined as the delivered price of coal; quantity data are in tons of an unspecified mix of coal types with the definite exclusion of metallurgical coal. Coke is treated as a separate category. Data are first computer-edited for consistency with previously collected data and then verified if any inconsistencies appear. A consistent coal data series is available since 1974 with comparable data also available for 1967 and 1971. While a one-year lag to publication is planned, that schedule was disrupted in 1972 and 1977 by the Census of Manufactures. Consequently, the 1977 Annual Survey was not released until September 1980. By 1982, the Bureau of the Census hopes to once again reduce this lag to one year.

The third candidate source of industrial sector prices are the Coke and Coal Chemicals reports published by the EIA. Data are collected quarterly and annually from all coke plants on EIA Forms 5 and 5-A. The plants are required to submit the total value and quantity of metallurgical coal purchased to produce coke. The current sample size is 59 coke plants. Since there are no missing data, incoming data are merely reviewed for consistency and published three months after the end of the reporting period. Consistent data are available back to 1970. Btu information is not collected, but coal rank information is collected so that price per million Btu can be estimated.

The remaining candidate source is Producer Prices and Price Indexes (PPI), prepared by the Bureau of Labor Statistics. The PPI does not provide sufficient data for the development of state-level price estimates since only a few regional and national prices are published. Furthermore, it lists f.o.b mine-mouth prices rather than delivered prices. Prices published in the PPI include regional prices categorized according to coal types and sizes generally used, either in the industrial, utility, or retail sectors. Only a national price index is provided for retail sales. In the industrial sector, national

contract and spot price indexes are reported separately for steam and metallurgical coals. No Btu information is collected and the data cover only bituminous and anthracite coals.

For the residential sector, the American Gas Association's Gas Househeating Survey is the most comprehensive data set available. This survey collected coal price data from 1971 through 1978 for cities where gas distributors are located. While the size of the sample declines over this time period, there is generally more than one annual price observation available for each state. Because no volume data are collected for the residential sector, a residential price series developed from the source cannot be volume weighted.

4.2 RECOMMENDATIONS

Review of information on coal markets (Charles River Associates 1977 and 1980), and of the price data for metallurgical and steam coal has indicated that these two types of coal are distinctly different products that generally sell in separate markets. Therefore, two price series are recommended for development: One for metallurgical coal and one for steam coal.

For metallurgical coal only two sources provide data, the Producer Price Index and Coke and Coal Chemicals Energy. Of these, only the EIA's Coke and Coal Chemicals has sufficient data for development of state-level price estimates and then only for about 20 states. Use of these data, however, will permit development of a metallurgical coal price series for the industrial sector in the states where coke production occurs.

In the case of steam coal, state-level prices can be developed for the utility, industrial, and residential sectors. For the utility sector, Cost and Quality of Fuels is clearly the best data source. It meets virtually all of the evaluation criteria and is published in the form needed, with state-level, volume-weighted prices per million Btu.

For the industrial sector the best source of steam coal price data is EIA-3, "Coal Consumption Report-Manufacturing Plants." Use of this data has several drawbacks, however. First, the data are presently unpublished.^(a)

(a) However, it was pointed out during the final report review process that the data are published as averages by state and SIC in early 1982.

Second, only 44 states have any price data reported, and disclosure problems require data aggregation within 7 groups of these states. Third, no data verification procedures are employed, and inspection of the preliminary data summaries reveals significant anomalies. In spite of these problems, it is recommended that efforts be made to utilize this data because they cover a substantial portion of total consumption and are definitely the best data available.

While the residential sector data are deficient in that collection has ceased and that the published data consist of price observations with no volume data available, a price series can be developed. It is recommended that the Gas Househeating Survey be used as the basis for the price series with prices for missing years imputed by estimating the relationship between residential and utility sector data.

4.3 NOTES ON IMPLEMENTATION

In implementing the above recommendations, the following practical and statistical aspects need to be noted.

1. Due to restrictions on disclosure of data, some metallurgical coal prices are reported for groups of states rather than individual states.
2. The imputation of residential sector coal prices for 1979 and later was carried out by segregating states that use bituminous coal from states that do not. For states that use bituminous coal, the following regression equation was estimated from 1971-1978 data.

$$\text{SCRSBPXX} = .3369 + 1.5617 \text{ SPXX} + c_{XX} \cdot \text{DXX} \quad (4.1)$$

(1.561) (13.898)

$$R^2 = 0.6783 \quad \text{d.f.} = 147 \quad \text{D.W.} = 1.7857$$

Where:

SCRSBPXX = residential sector coal prices for state XX

SPXX = spot price of bituminous coal for each state or group of states

DXX = a dummy variable for each state or group of states, except Alabama which is the reference state.

TABLE 4.4 Estimated Values of c_{XX} for Equation 4.1

State XX	c_{XX}	t	State XX	c_{XX}	t
DE	0.4781	1.389	NJ	-0.2563	-0.736
GA	-0.0955	-0.343	NY	0.4761	0.845
IL	0.1581	0.612	NC	0.1145	0.444
IN	0.5077	1.956	ND	0.8183	2.792
IA	0.6765	2.615	OH	0.4530	1.753
KS	-0.1559	-0.561	PA	0.3589	1.386
KY	0.1920	0.742	SC	0.3516	1.264
MD	0.0864	0.335	TN	-0.0239	-0.092
MI	0.6519	2.526	VA	0.5047	1.953
MN	1.5792	5.634	WI	1.0446	4.032
MO	-0.0996	-0.385	CT,NH,RI,&VT	0.0684	0.260
ME	0.4427	1.517	WV	-0.500	-1.802

The estimated value of c_{XX} and the associated t values are shown in Table 4.4. (a)

For states that do not use bituminous coal, the estimated regression equation is as follows:

$$\text{SCRSBPXX} = -0.0971 + 3.1876 \text{ ASPXX} + 1.2003 \text{ DXX} \quad (4.2)$$

(-0.359) (6.029) (6.767)

$$R^2 = 0.6916 \quad \text{d.f.} = 32 \quad \text{D.W.} = 1.0418$$

Where:

ASPXX = average spot price for all types of coal from Cost and Quality of Fuels for Electric Utility Plants for state XX

DXX = the dummy variable for state XX; it assumes values of 1.0 for Montana, Nevada, and South Dakota, and of 0.0 for Colorado, Idaho, Utah, Washington, and Wyoming.

(a) For a simple explanation of the regression analysis, see Appendix F.

To impute the 1970 state-level coal prices from the EEI data on coal prices, the following equation was estimated from 1971-1978 data.

$$\log \text{ASPXX} = 0.0294 + 0.9449 \log \text{EEIPXX} \quad (4.3)$$

(2.111) (38.510)

$$R^2 = 0.8322 \quad \text{d.f.} = 299 \quad \text{D.W.} = 0.9303$$

Where:

EEIPXX = the average cost of coal for each state from the EEI
Statistical Year Book

3. The industrial sector coal prices for 1970, 1972, and 1973, as well as for states for which all ASM and CM data are not directly available, the following regression equation is estimated from pooled cross-section data of 1971 and 1974 through 1978.

$$\begin{aligned} \text{SCINPPXX} = & 15.2784 + .6598 \text{CPXX} + c_{XX} \cdot \text{DXX} + g_{XX} \cdot (\text{DXX} \cdot \text{CPXX}) \\ & (9.200) \quad (13.785) \\ & - 8.9683 t \quad (4.4) \\ & (-8.239) \end{aligned}$$

$$R^2 = 0.8595 \quad \text{d.f.} = 217 \quad \text{D.W.} = 2.0289$$

Where:

SCINPPXX = industrial sector coal prices in physical unit for state XX

CPXX = average coal price for state XX from Cost and Quality of Fuels for Electric Utility Plants (1973-1977) or the EII Statistical Year Book (1970-1972)

DXX = a dummy variable for each state XX for a full set of data were available, except Ohio which was taken as the reference state.

t = a time dummy; equals 1.0 for 1973 and earlier years, 0.0 for 1974 and thereafter.

The estimated values of c_{XX} and the associated t values are shown in Table 4.5.

TABLE 4.5 Estimated Values of c_{XX} for Equation 4.4

<u>State XX</u>	<u>c_{XX}</u>	<u>t</u>	<u>State XX</u>	<u>c_{XX}</u>	<u>t</u>
AL	-2.3139	-1.214	NE	-5.0278	-2.637
AZ	3.7146	1.368	NH	9.1377	3.665
CO	-2.5100	-1.033	NJ	-5.7861	-2.855
CT	4.0930	0.931	NM	4.6377	1.665
DE	-4.0217	-1.459	NV	1.6090	0.668
DC	-3.6393	-1.318	NY	-1.1127	-0.580
FL	-4.8773	-2.426	OK	0.0701	0.029
GA	-0.3876	-0.195	OR	-0.8628	-0.320
IA	-1.0946	-0.574	PA	-3.4693	-1.824
IL	0.0161	0.009	SC	0.2512	0.130
IN	2.2622	1.182	SD	4.7089	1.089
KS	-1.4162	-0.731	TN	-2.5975	-1.367
KY	2.2871	1.198	TX	6.0045	1.141
MD	-7.2896	-1.280	UT	-5.3718	-2.798
MA	6.2741	2.657	VA	-3.6779	-1.882
MI	0.8499	0.446	VT	-7.0296	-2.148
MN	-1.8805	-0.965	WA	12.5756	4.605
MO	1.2033	0.626	WV	-2.5265	-1.329
MS	-6.4479	-2.317	WI	5.1359	2.700
MT	8.3147	3.322	WY	0.0035	0.001
NC	0.6809	0.354			
ND	.5831	.233			

Note that the term $g_{XX} \cdot (D_{XX} \cdot CP_{XX})$ was calculated only for Maryland and Texas. The values of g_{XX} and the associated t-value are as follows:

<u>State XX</u>	<u>g_{XX}</u>	<u>t</u>
MD	-0.1476	-0.610
TX	-1.2112	-3.152

4.4 SUMMARY OF AGENCY COMMENTS

Formal review of a draft working paper on the review of available data sources for use in developing the coal price series generally concurred with the recommendations on which data sources to use, and those concerning the development of separate price series for steam coal and metallurgical coal in the industrial sector. Additional data base related information was also offered and has been incorporated into the final report as presented in Sections 4.1 through 4.3.

There are three points which deserve mention:

1. Development of coal price series for residential and commercial sectors should be considered.

Response: Coal price series have been developed for the residential sector for those states with quantifiable coal use in that sector, as reflected in SEDS. However, there was no data for imputing commercial sector prices by state and, therefore, no commercial sector price series were developed. If there is need for commercial coal prices, we recommend using the residential sector prices as surrogates.

2. The extension of the review criteria on the comprehensiveness in geographical coverage and consistency in data collection procedures would tend to result in disregard of some valuable coal price information collected by the states.

Response: We agree that some useful data sources collected by individual states would be disregarded as a result of strict adherence to the criteria referred to. We are incorporating this point as part of our recommendation on possible validation of the resulting data base. (See Volume I Chapter 2 of this report).

3. The draft working paper, as written, was "factual," but "shallow".

Response: We believe that the "shallowness" comment resulted from a lack of understanding of the overall scope and objectives of the total project. Partly due to our attempt to minimize the duplicate materials contained in each working paper on the price series data base review for individual fuels, we did not provide sufficient information on the overall project. We believe that, in the context of the total project and the final report, that particular comment has become moot.

5. DISTILLATE FUEL

Distillate fuel refers to the class of petroleum products condensed from vapor during the petroleum refining process. It includes the following homogenous products: Kerosene; No. 1, No. 2, and No. 4 fuel oils; and No. 1-D, No. 2-D, and No. 4-D diesel fuels.

Distillate fuels are consumed in all five sectors considered in this report. Typically, distillate fuels are used for space heating in the commercial and residential sectors, process fuel and chemical feedstocks in the industrial sector, and fuel for the generation of electricity in the utility sector; diesel and gasoline fuels are used by trucks, buses, cars, railroads, and ships in the transportation sector. In 1979, distillate fuels (including diesels but excluding gasoline) contributed an estimated nine percent, or 7.09 quads, to the total U.S. consumption of 79 quads. Of the 7.09 quads, 38 percent was accounted for by the transportation sector; 33 percent by the residential and commercial sectors combined; 25 percent by the industrial sector; and 4 percent by the electric utility sector..

Note that, since separate price series for kerosene, diesel fuels, and gasoline are being developed, the distillate price series consists mainly of fuel oil prices.

5.1 DATA BASE REVIEW

A working list of published sources of distillate prices was compiled from: the American Gas Association's (AGA) Energy Statistics: North American and World Sources, 1977; the Ideamatics, Inc. report, Federal Energy Data System Analysis and Evaluation, 1978; the Energy Information Administration's EIA Publications Directory, 1980; and a search of bibliographies of energy-related publications. Preliminary examination of the identified sources of distillate price data narrowed the field of candidate data bases to eight that met or nearly met the established review criteria. Listed in Table 5.1 by source organization, these eight data sources were evaluated in depth as potential sources for the EIA distillate price series. Among sources reviewed and determined unsuitable for EIA use were Oil and Gas Journal, Oil Daily, Oil Express, Journal of Commerce, Energy User News, Fuel Oil and Oil Heat,

TABLE 5.1. Candidate Sources of Distillate Price Data

<u>Organization</u>	<u>Publication</u>	<u>Forms Used</u>
Energy Information Administration	<u>Prices and Margins of No. 2 Distillate Fuel Oil</u>	EIA-9A, 9, & FEA-P112-M-1, CLC-92
Energy Information Administration	<u>Cost and Quality of Fuels for Electric Utility Plants</u>	FPC-423
Edison Electric Institute	<u>Statistical Year Book of the Electric Utility Industry</u>	Uniform Statistical Report (Annual)
Bureau of the Census	<u>Annual Survey of Manufactures</u>	MA-100
American Gas Association	<u>Gas Househeating Survey</u>	---
Bureau of Labor Statistics	<u>Consumer Prices: Energy</u>	---
Bureau of Labor Statistics	<u>Producer Prices and Price Indexes</u>	---
McGraw-Hill, Inc.	<u>Platt's Oil Price Handbook and Oilmanac</u>	---

Oil Buyer's Guide, Energy User's Guide, and Petroleum Intelligence Weekly.

These publications were either secondary sources of distillate price data, did not publish retail prices, or provided prices for very limited geographic areas.

The most comprehensive distillate price series identified was that collected on EIA Form 9A. Titled "No. 2 Distillate Price Monitoring Report," EIA-9A collects state-level volume and price per gallon data for No. 2 fuel oil and No. 2-D diesel for four sectors. A volume-weighted composite distillate price is calculated from the data and published in various documents, including the EIA's Prices and Margins of No. 2 Distillate Fuel Oil and Monthly Petroleum Product Price Report. Although price data for all states are collected by the EIA, prices are aggregated by DOE region for publication, with one exception: Prices and Margins contains residential sector prices for 24 states in DOE Regions 1, 2, 3, 5, and 10. The sample will not permit estimation of the remaining state prices at an adequate confidence level.

EIA-9A questionnaires are sent to retailers and resellers of No. 2 fuel oil and No. 2-D diesel. Companies included in the sample were chosen from respondents to EIA-402, "Fuel Oil Distribution Survey," which is sent to all firms retailing or reselling distillate, kerosene, and residual fuels. Only companies selling distillate were included in the EIA-9A sampling frame. Each of the 24,000 company-state units in the EIA-9A sampling frame represents an individual company's sales in a particular state. A stratified random sample of 3000 company-state units, representing approximately 1800 individual companies, is required to submit data each month; the response rate is averaging 75 percent. Although nonresponses have resulted in some biases in the data, no imputation methodologies have been employed to adjust for missing data. The EIA has indicated, however, that imputation methods will be developed if nonresponse rates do not decline. Collected data is validated through selective audits, and the lag to publication is about 45 days.

EIA-9A, which came into use November 1980, was preceded by Form EIA-9, "No. 2 Heating Oil Supply/Price Monitoring Report." EIA-9 collected No. 2 fuel oil volume and unit price data comparable to the No. 2 fuel oil data collected by EIA-9A, but was based on a different sample. The differences in samples between EIA-9 and EIA-9A are such that any change in average prices, when comparing the two data sets, is reflective not only of actual change in prices, but also of the change in samples and sampling frames. In the EIA publication Heating Oil Prices and Margins, the EIA-9 price data for No. 2 fuel was reported for the same 24 states as the EIA-9A distillate data in Prices and Margins of No. 2 Distillate Fuel Oil. These forms were preceded by FEA-P112-M-1, which collected the same data No. 2 fuel oil from January 1976 and by CLC-92, which originated in January 1975.

Of the eight candidate sources of distillate price data, EIA-9A is the only source reporting prices for more than one sector. However, the EIA-9A sector definitions (residential, commercial/industrial, institutional/utility, and other) differ from the definitions established for the development of the price series. The EIA-9A industrial sector includes apartment and commercial buildings, and, therefore, end-uses like cooking, heating, and refrigeration. The institutional/utility sector is composed of public utilities and state and federal organizations. A catch-all, the "other" sector contains any end-use

sales that are not classified as residential, commercial/industrial, or institutional/utility. The residential sector definition used by EIA-9A is the only sector definition comparable to that established for this study. See Table 5.2 for a summary of data base characteristics.

Two of the remaining candidate series covered the utility sector: Edison Electric Institute's (EEI) Statistical Year Book of the Electric Utility Industry, and the EIA's Cost and Quality of Fuels for Electric Utility Plants. Although both data bases meet the established review criteria, the EEI Statistical Year Book is less suitable for use in developing this price series because it does not report prices for distillate. EEI reports prices for "oil," which is defined to include crude oil, residual fuel oils, and small amounts of tar and gasoline, in addition to distillate fuels.

The price data of Cost and Quality is of adequate quality for the EIA distillate series. In Cost and Quality, average delivered prices of No. 2 and No. 4 fuel oils are reported in cents per million Btu and in dollars per barrel, and can be used to form a distillate price estimate for states. Price and quantity data are collected monthly by state (except for Alaska and Hawaii which are omitted from the survey), on FPC Form 423, "Monthly Report of the Cost and Quality of Fuels for Electric Utility Plants." Both annual and monthly editions of Cost and Quality are published and data are available since 1973.

Response to FPC-423 is required of all electric utilities with a generating capacity of at least 25 megawatts, for those months in which fossil fuels are actually purchased. Verification is carried out by sampling 280 utilities each month from the responding universe of 900 to 950 utilities. Any missing data are represented by weighted averages of previous values, and the assembled data are validated through both computer audits and telephone checks. Consistent data are available back to 1973, the only changes in collection methods having been minor form alterations in 1974 and 1977. The lag to publication for the annual edition is usually about five months.

Other than EIA-9A, the only source of industrial sector distillate price data is the Annual Survey of Manufactures (ASM) and the Census of Manufactures (CM), compiled by the U.S. Department of Commerce, Bureau of the Census. The ASM/CM industrial sector coverage is more narrowly defined

TABLE 5.2. Comparison of Candidate Distillate Price Data Bases

Characteristic	EIA-9A	FPC Form 423	EEI	ASM MA-100	AGA	CPI	PPI	Platt's
Definition of distillate includes:								
No. 1 fuel oil	-	-	-(b)	+	+	-	-	+
No. 2 fuel oil	+	+	+(b)	+	+	+	+	+
No. 4 fuel oil	-	+	+	+	-	-	-	+
Kerosene	-	+	-	-	+	-	-	-
No. 1-D diesel	-	-	-	+	-	-	-	-
No. 2-D diesel	+	-	-	+	-	-	-	+
Sectoral coverage:								
Residential	+	-	-	-	+	+	-	-
Commercial	(a)	-	-	-	-	-	-	-
Industrial	(a)	-	-	+	-	-	-	-
Electric Utility	+	+	+	-	-	-	-	-
Adequate data for state level estimates	+	+	+	+	-	-	-	-
Timely availability of data	+	+	+	-	+	+	+	+
Minimal missing data	+	+	+	+	-	-	-	-

+: Yes or available

-: No or unavailable

(a) Commercial and industrial prices are combined.

(b) Also includes crude oil, residual oil, and small amounts of tar and gasoline.

than that adopted for this study, covering only the manufacturing industry while the sector definition used in this study includes agriculture, mining and construction as well. The purchased distillate for which cost and quantity data are reported is defined to include No. 1, No. 2, and No. 4 fuel oils, light diesel type fuel oil; and light gas enrichment oil. Cost is "delivered cost" and is published, along with quantities, for each state and the District of Columbia. From these data, which are available back to 1950, volume-weighted, state-level distillate price estimates can be calculated.

The 70,000 manufacturing companies in the ASM sample are required to submit Form MA-100 each year. Firms chosen for the sample are initially chosen on the basis of size; all firms with 250 or more employees are included in the sample, then smaller firms are included to constitute a probability sample. Energy intensive manufacturing companies tend to have a high inclusion rate because they are generally larger firms. No imputation methods are employed by the Bureau of the Census and data validation procedures consist of computer and analytical checks for consistency with historical trends and current industry patterns.

The major problem with the ASM data is its lag to publication. Because work on the ASM has been repeatedly interrupted by the Census of Manufactures, the Bureau of the Census has not been able to keep the lag to publication under one year. The most recent ASM currently available is for 1979. Should the Bureau of the Census be successful in limiting the lag to publication, this data base would be well suited for use in the EIA distillate price series.

Distillate price data for the residential sector are published in the AGA's Gas Househeating Survey and in the Bureau of Labor Statistics' Consumer Prices: Energy (CPI). Although neither of these sources publishes data for the entire United States, the data from each can be used to generate state-level price estimates for some states. Both meet most of the established review criteria (see Table 5.2), but both have the drawback that the data represent average price observations rather than volume-weighted average prices.

Gas Househeating Survey reports average delivered prices of No. 1 and No. 2 fuel oils in dollars per million Btu. The price data are collected in a survey of natural gas utilities, and are the competitive prices collected and reported by gas utilities for the particular cities which they serve. Repre-

senting 84 percent of the service to residential consumers, the approximately 200 utilities in the sample are all AGA members who respond voluntarily to the survey. Prices are collected annually; the collected data are compared to an expected range and outlying values are rechecked. Any missing data are marked "unavailable." Consistent data are available for the years 1971 to the present, and the annual publication lag is about nine months.

The CPI price data are population-weighted averages, including taxes, that are reported in dollars per gallon. The Bureau of Labor Statistics uses field agents to gather the data from No. 2 heating oil dealers; about 450 dealers in 85 cities are surveyed each month. However, heating oil price data are published for only 28 of the larger cities in the survey and for the four Census Divisions, with a lag to publication of three weeks. The BLS staff checks the collected data for inconsistencies, marking any missing data. A major sample size change in 1978 makes comparison of the data before and after 1978 difficult, but heating oil prices are available for the period since 1973.

The last two candidate data bases, Producer Prices and Price Indexes (PPI) and Platt's Oil Price Handbook and Oilmanac, do not contain data for end-use sectors. In addition, they have the drawback of reporting average price observations rather than volume-weighted average prices. The PPI publishes average realized wholesale prices for No. 2 fuel oil by Census Region. Platt's reports terminal prices for kerosene/No. 1, No. 2 and No. 4 fuel oils. Platt's does not cover the entire United States, but reports prices for 25 cities in 19 eastern states.

5.2 OPTIONS FOR IMPUTING STATE-LEVEL PRICES

None of the available data bases contain prices for all states, for even one end-use sector. As a result, development of the price series requires extensive data imputation. In this section the options for generating state-level distillate prices for the residential, commercial, industrial, and electric utilities sectors are explained. Although the end-use sector classification adopted in this study includes transportation, the transportation sector is not included in this discussion of distillate prices since separate price series for gasoline and diesel fuel are developed to cover the transportation sector. Note also that a separate price series is developed for kerosene.

In this discussion, data sources for the electric utility sector price series are summarized first. Then the EIA-9A data and various imputation options for the residential, industrial, and commercial sectors are discussed in sequence.

5.2.1 Electric Utility Sector

The most complete and consistent source of data for the electric utility sector is Cost and Quality of Fuels for Electric Utility Plants. This data source covers the time period from 1973 to the present. In states for which no price data are available for this period, it is most likely that no distillate fuels were used or purchased by electric utilities in the state. Therefore, there is no need to impute prices for such cases.

For 1970 through 1972 and for states lacking 1973 data, the price series can be developed from EEI Statistical Year Book data. The EEI data cannot be used directly, however, since the reported prices are for a broad range of petroleum products, rather than just distillates. Steps required for use of the EEI data are as follows:

Step 1. Estimate the relationships between EEI state data and Cost and Quality state data for 1974 through 1980.

$$PCQXX_t = a + b \cdot PEEIXX_t + \sum_{XX=1}^{51} c_{XX} \cdot DSXX \quad (5.1)$$

Where:

$PCQXX_t$ = price observation from Cost and Quality for state XX, in year t

$PEEIXX_t$ = the price observation from Statistical Year Book for state XX, in year t

$DSXX$ = dummy variable for state XX

In actual regression runs, different versions of Equation 5.1 were tried and the logarithmic form was adopted. Moreover, because the Cost and Quality data contained Btu prices representing different proportions of No. 2 and No. 4 distillate fuels used by utilities in different years, separate regressions were run for physical unit prices (Equation 5.1a) and Btu unit prices (Equation 5.1b).

$$\log PCQXX_t = \frac{.2670}{(3.273)} + \frac{.9986}{(46.334)} \log PEEIXX_t + \sum_{XX=1}^{51} c_{XX} \cdot DSXX \quad (5.1a)$$

$$R^2 = .8759 \quad d.f. = 321 \quad D.W. = 1.760$$

$$\log PCQXX_t = \frac{.3260}{(4.988)} + \frac{1.0011}{(44.899)} \log PEEIBXX_t + \sum_{XX=1}^{51} c_{XX} \cdot DSXX \quad (5.1b)$$

$$R^2 = .8692 \quad d.f. = 321 \quad D.W. = 1.735$$

Table 5.3 presents the estimated coefficients and related statistics for the physical unit prices. Similarly, Table 5.4 presents those estimates and statistics for the Btu price equation.

Step 2. Calculate the missing state prices from the parameter estimates of Equations 5.1a and 5.1b respectively for the physical unit prices and Btu prices.

5.2.2. Status of EIA Data for Other Sectors

The data source for state-level distillate fuel oil prices which most closely satisfies the evaluation criteria for this project is the EIA-9A, EIA-9, and FEA-P112-M-1 series. EIA-9A, "No. 2 Distillate Price Monitoring Report", collects data on prices, sales volumes, and costs of No. 2 fuel oil and No. 2 diesel fuel for the marketing levels of refining, reselling, and retailing. The sales categories are residential, industrial/commercial, institutional/utility, other ultimate customers, and nonultimate customers. The resulting information on average monthly prices and gross margins for the ten DOE regions and for 24 states in DOE Regions 1, 2, 3, 5, and 10 are published in EIA's Prices and Margins of No. 2 Distillate Fuel Oil and the Monthly Petroleum Product Price Report. Utilization of this data for the state-level distillate fuel prices requires that problems relating to sectoral classifications, geographic coverage, and time coverage be addressed.

TABLE 5.3. Estimated Values of c_{XX} for Equation 5.1a

State	c_{XX}	t	State	c_{XX}	t
AL	-0.1475	-1.6877	NC	-0.1346	-1.5415
AR	-0.1266	-1.4490	ND	0.079	0.0910
AZ	-0.0971	-1.1111	NE	0.0109	0.1256
CA	-0.2493	-2.8501	NH	0.0116	0.1232
CO	-0.0540	-0.6181	NT	-0.1674	-1.8484
CT	-0.1654	-1.8261	NM	-0.0797	-0.9130
DC	-0.1480	-1.6351	NV	0.0174	0.1997
DE	-0.0330	-0.3783	NY	-0.1155	-1.3222
FL	-0.0185	-0.2118	OH	-0.2017	-2.3069
GA	-0.0662	-0.7575	OK	-0.0291	-0.3334
HI	0.0481	0.5315	OR	-0.1294	-1.4804
IA	-0.1338	-1.5314	PA	-0.1228	-1.4063
ID	-0.0164	-0.1646	RI	-0.0330	-0.2790
IL	-0.1671	-1.9120	SC	0.2472	2.8266
IN	-0.1932	-2.2111	SD	0.0410	0.4351
KS	0.0679	0.7767	TN	-0.0595	-0.6575
KY	-0.0558	-0.6390	TX	-0.0321	-0.3683
LA	-0.0939	-1.0748	UT	0.0153	0.1760
MD	-0.0885	-0.9773	VA	-0.0159	-0.1826
ME	0.0995	1.1002	VT	-0.0903	-0.9554
MI	-0.1207	-1.3816	WA	-0.2518	-2.3439
MN	-0.0249	-0.2855	WI	-0.1358	-1.5550
MO	-0.0313	-0.3582	WV	-0.2195	-2.4187
MS	-0.0461	-0.5281	WY	-0.0642	0.7096
MT	-0.1196	-1.3235			

TABLE 5.4. Estimated Values of c_{xx} for Equation 5.1b

State	c_{xx}	t	State	c_{xx}	t
AL	-0.2043	-2.2656	MT	-0.3048	-3.2665
AR	-0.1220	-1.3541	NC	-0.1763	-1.9558
AZ	-0.1196	-1.3262	ND	-0.0498	-0.5529
CA	-0.2503	-2.7739	NE	-0.0037	-0.0414
CO	-0.0737	-0.8170	NH	0.0186	0.1907
CT	-0.1742	-1.8646	NJ	-0.1901	-2.0337
DC	-0.1803	-1.9314	NM	-0.1325	-1.4697
DE	-0.0462	-0.5129	NV	0.0057	0.0627
FL	-0.0131	-0.1455	NY	-0.1211	-1.3437
GA	-0.0801	-0.8888	OH	-0.2387	-2.6437
HI	0.0693	0.7433	OK	-0.0877	-0.9737
IA	-0.2017	-2.2364	OR	-0.1912	-2.1182
ID	-0.0879	-0.8550	PA	-0.1439	-1.5964
IL	-0.1860	-2.0625	RI	-0.0538	-0.4397
IN	-0.2536	-2.8122	SC	0.2482	2.7506
KS	0.0599	0.6645	SD	0.1053	1.0810
KY	-0.0913	-1.0133	TN	-0.1171	-1.2530
LA	-0.1198	-1.3297	TX	-0.0633	-0.7027
MD	-0.0954	-1.0214	UT	-0.0168	-0.1867
ME	0.0960	1.0291	VA	-0.0228	-0.2530
MI	-0.1441	-1.5984	VT	-0.1638	-1.6777
MN	-0.0334	-0.3702	WA	-0.2869	-2.5871
MO	-0.0701	-0.7771	WI	-0.1928	-2.1376
MS	-0.0501	-0.5556	WV	-0.3022	-3.2215
			WY	0.0004	0.0044

Sector Definitions

As explained in Table 5.5 and the following discussion, there are several problems in utilizing data from the EIA-9A series. First, the prices for commercial and industrial customers cannot be disaggregated. This combined price series is probably higher than purely industrial sector prices, and lower than purely commercial sector prices, because industrial customers purchase larger volumes with higher discounts. With the information available, it is not possible to disaggregate the combined prices into separate prices for commercial and industrial sectors without making certain arbitrary assumptions. Second, the prices for electric utilities are lumped with "institutional" customers such as government agencies.

TABLE 5.5. Comparison of End-Use Sector Categories

<u>Classification Used in this study</u>	<u>Classification Used in EIA-9A</u>
Residential	Residential
Commercial	Industrial/Commercial
Industrial	Institutional/Utility
Transportation	Other Ultimate Consumers
Electric Utilities	

Geographical Coverage

The geographical coverage of the published EIA-9A and EIA-9 series is more detailed for the residential sector than for the other sectors. In the residential sector, monthly prices for most DOE regions, for the U. S. and for individual states in Regions 1, 2, 3, 5, and 10 are published. Prices for the industrial/commercial, institutional/utility, and other customers are available at the regional and national levels only. The data on gross margins for refiners, resellers, and retailers are limited to DOE regional averages. In contrast, the FEA-P112-M-1 and CLC-92 data are classified by nine Census Regions.

While EIA-9A collects data for all 50 states and the District of Columbia, gaps in the published data series occur due to disclosure restrictions or statistical deficiencies in the data for individual states. Thus it is necessary to adopt reasonable procedures to impute prices for the missing states and data years.

Although the Bureau of Labor Statistics also collects and publishes data on residential heating oil prices, these data are not used in development of the imputation strategies, except for use of national average prices prior to 1975. The published portion generally covers the same states as the EIA-9A data, although the underlying data cover all 50 states. Without special permission, it is not possible to access the unpublished BLS data and, even if accessible, the unpublished data could not be disclosed.

TABLE 5.6. Data Sources and Time Periods

<u>Data Source Form</u>	<u>Time Coverage</u>	<u>Comments & Notes</u>
EIA-9A	Nov. 1980 to present	Change in sample design in Oct. 1980
EIA-9	Nov. 1977 to Oct. 1980	
FEA-P112-M-1	Jan. 1976 to Oct. 1977	Change in sample design in Nov. 1977
CLC-92	June 1975 to Dec. 1975	

Time Coverage

The availability over time of the EIA-9A data series is shown in Table 5.6. Only five years of data are presently available. Another problem related to the time dimension of the data is that in most cases only monthly data are published; there are no annual average prices. This means that monthly quantity shares in the annual total have to be derived for weighting purposes. Because of the differences in data availability for different sectors, the discussions of available options for developing state-level distillate fuel prices are presented on a sector-by-sector basis.

5.2.3 Residential Sector

The EIA-9A series publishes monthly residential sector prices for 23 states and Washington, D.C. in DOE regions 1, 2, 3, 5, and 10; DOE regional averages except for Region 6; and U. S. average prices. These data are continuously available from November 1977 through the present. Data on the average gross margins for nonrefiners by DOE region are also available for the same period. Monthly average prices for the nine Census Divisions are available for the period January 1975 to October 1977.

To the extent that monthly state prices are available, they are used to derive average annual prices. For DOE Regions 4, 7, 8, and 9, only monthly regional average prices and regional gross margins are published; there are no state data. For Region 6, even the regional average price data are unpublished.

The procedures for deriving annual average state prices from these data and for generating state prices for earlier periods will be discussed in the following sections.

Basic Logic

Given the data availability described above, the approach used in developing the price series is that the published EIA data originating from the EIA-9A and 9, FEA-P112-M-1, and CLC-92 sources will be used as much as possible. Under this approach, there are three sequential points from which the imputation proceeds:

1. Are monthly state-level prices available for a particular year?
2. If not, are regional average prices for that particular year available?
3. If neither state-level prices nor regional average prices are available, the national average price is used in imputing the regional and then the state prices.

In Figure 5.1 these three steps are used to illustrate the logic of the price generating procedure. If the answer to the first question is in the affirmative, then the published state-level prices are used for the states. The only work needed is the computation of annual average prices from the published monthly prices weighted by the monthly consumption volume. As mentioned, this is the case for the residential sector in 23 states and the District of Columbia, and in DOE Regions 1, 2, 3, 5, and 10 for the period 1978-1980.

If the first question is answered in the negative, then the second question is asked. If the regional average prices are published, but state prices are not, state price estimates are developed based on assignment of Platt's terminal prices to states. These are then weighted and adjusted to equal the regional average price.

When the first two questions are both answered in the negative, the third alternative is implemented. The national average price is used to constrain the weighted average of the ten regional prices and allow calculation of the

FIGURE 5.1. Residential Sector Distillate Price Imputation Logic for 1975 Through 1980

unknown price for Region 6.^(a) State prices are then derived from Platt's data in the same manner as when the regional price is available from the EIA-9A series.

Procedures for 1975-1980

The following discussion sets out the steps and equations required for the computation of state prices in the period 1975-1980 for which EIA-9A series data are available either at the state or regional levels. The procedures for prior years are described later, as are details of the development of annual prices from the monthly EIA-9A series data and details of the procedure for assigning Platt's data to particular states. Terms in the procedural discussion are defined as follows:

- Step 1. Use state prices ($PXX_{t,m}$) if available from the EIA-9A series. Since monthly volume weights are not available from the EIA-9A series, apply monthly heating-degree-day weights ($HDDXX_{t,m}$) to calculate the annual average price for each state (PXX_t) and enter PXX_t in the data base.

$$PXX_t = \frac{\sum_{m=1}^{12} (PXX_{t,m} \cdot HDDXX_{t,m})}{\sum_{m=1}^{12} HDDXX_{t,m}} \quad (5.2)$$

Where:

$PXX_{t,m}$ = volume-weighted average price for state XX, in year t month m,

$HDDXX_{t,m}$ = monthly heating-degree-day weight for state XX, in month m, in year t, from the National Oceanic and Atmospheric Administration Historical Climatological Series 5-1 table of normal heating degree days.

-
- (a) Note that difficulties encountered in implementing this particular approach led to the substitution of an alternate approach. See Step 3 of the procedure for 1975-1980 in the following discussion.

Step 2. Use regional prices ($P_{j,t,m}$) if available.

- i. Apply monthly heating-degree-day weights ($HDD_{j,t,m}$) to calculate the annual average price for each region ($P_{j,t}$).

$$P_{j,t} = \frac{\sum_{m=1}^{12} (P_{j,t,m} \cdot HDD_{j,t,m})}{\sum_{m=1}^{12} HDD_{j,t,m}} \quad (5.3)$$

- ii. Assign Platt's prices ($PLXX_{j,t}$) to each state for which EIA-9A series prices are unavailable, as described in the following section.
- iii. Apply SEDS volume weights ($SVXX_{j,t}$) and set the weighted average of state price estimates ($PLXX_{j,t}$) from Platt's equal to the regional price ($P_{j,t}$) to calculate the adjustment factor ($A_{j,t}$).

$$P_{j,t} = A_{j,t} \cdot \frac{\sum_{XX=1}^{N_j} (PLXX_{j,t} \cdot SVXX_{j,t})}{\sum_{XX=1}^{N_j} SVXX_{j,t}} \quad (5.4)$$

$$A_{j,t} = P_{j,t} \div \frac{\sum_{XX=1}^{N_j} (PLXX_{j,t} \cdot SVXX_{j,t})}{\sum_{XX=1}^{N_j} SVXX_{j,t}} \quad (5.4a)$$

Where:

N_j = number of states in region j

- iv. Apply the adjustment factor ($A_{j,t}$) to the state price estimate from Platt's ($PLXX_{j,t}$) to derive the imputed state prices (PXX_t) and enter PXX_t in the data base.

$$PXX_t = A_{j,t} \cdot PLXX_{j,t} \quad (5.5)$$

Step 3. Calculate a regional price for Region 6.

- i. Using prices for the West South Central Census Region in 1976 and 1977, calculate the adjustment factor ($A_{6,t}$) which is the average ratio of the West South Central price to the weighted average of state price estimates for the states in the West South Central Region.

$$A_{6,t} = \frac{1}{2} \sum_{t=76}^{77} \left[\frac{P_{WSC,t}}{\frac{1}{4} \left[\sum_{XX=1}^4 PLXX_{WSC,t} \cdot SVXX_{WSC,t} \right] - \sum_{XX=1}^4 SVXX_{WSC,t}} \right] \quad (5.6)$$

Where:

$A_{6,t}$ = adjustment factor for DOE Region 6 in year t
 $P_{WSC,t}$ = price in the West South Central Region in year t

- ii. Proceed as in Step 2.ii through 2.iv.

Assignment of Platt's Prices to States

Platt's Oil Price Handbook and Oilmanac contains price information on distillate and residual oils in the form of cargo prices and refinery and terminal prices. Prices are FOB refineries, pipeline terminals or tanker terminals. Products included in the "distillate and residual oils" category are kerosene, No. 1 fuel, No. 2 fuel, No. 2 diesel fuel, No. 4 fuel, No. 6 fuel with different sulfur levels, marine diesel, marine gasoils, and Bunker C fuel. Since the emphasis in this imputation is on residential, commercial, and industrial heating use of distillates, Platt's refinery and terminal prices for No. 2 fuel are used, supplemented by that for No. 2 diesel when necessary.

The general procedure proposed for assigning state prices is as follows:

1. Assign to each state the refinery and terminal price for No. 2 fuel for the city or port located in that state; substitute the No. 2 diesel price if necessary.
2. If there is more than one city or port in a state, calculate and assign the average price.
3. If Platt's lists no city or port for a state, two alternatives are adopted. In order of priority, they are: 1) substitute the price for the city or port believed to be the point of origin for heating oil supply to the state under consideration; 2) calculate and substitute the regional average price based on Platt's.

The actual assignment of Platt's distillate prices to states is shown in Volume I Table 4.4 of this report.

Deriving Annual Average Prices From Monthly Data

For most of the EIA-9A series data at the state, regional, and national levels, only monthly prices are available; there is no annual average price published. To develop the required price series, the monthly data need to be converted to annual data. To do this, weights in the form of quantity shares by month are needed. Ideally such weights can be calculated from quantities sold in each state for each month of the year. If the state data are not available, then the monthly data from the region can be substituted. If the regional monthly data are not available, then the monthly pattern from a nearby region for the same year or that of the same region in previous years or, lastly, national monthly data can be substituted. Lacking any of the above information, the simple average method could be used to derive the annual average prices. If simple averaging of the monthly data were used, however, there would be bias due to the much smaller volume of distillate sales to residential customers in the summer months.

In implementation, attempts to use the unpublished monthly consumption data of the EIA-9A series were not successful. Moreover, it was considered too costly to use the National Oceanic and Atmospheric Administration (NOAA)

population-weighted state heating-degree-days for individual years for each state. Therefore, the normal heating-degree-days data published by NOAA are used as the monthly weights.

Procedure For Earlier Years

Before to 1975, there were no regional average prices available from the EIA-9A series. For these years, however, the imputation procedure is the same once regional prices have been estimated, as it is for later years. The logic is shown in Figure 5.2.

- Step 1. Aggregate the imputed state prices ($PXX_{j,t}$) for 1975, 1976, and 1977 using the state volume weights ($SVXX_{j,t}$) within each region to estimate prices for the DOE regions ($PDOE_{j,t}$). (This is necessary because the data is published for Census Regions).

$$PDOE_{j,t} = \frac{\sum_{XX=1}^{N_j} (PXX_{j,t} \cdot SVXX_{j,t})}{\sum_{XX=1}^{N_j} SVXX_{j,t}} \quad (5.7)$$

Where:

N_j = the number of states in DOE region j

- Step 2. Apply regression techniques to the pooled EIA-9A data for the period 1975 through 1980 to estimate the time trend of relationships of regional prices to national average prices developed from the EIA-9A series and published in the EIA Annual Report to Congress.

$$P_{j,t} = a + b \cdot PUS_t + \sum_{j=2}^{10} c_j \cdot RD_j \quad (5.8)$$

Where:

RD_j = a dummy for each region, except Region 1

FIGURE 5.2. Residential Sector Distillate Price Imputation Logic for 1970 Through 1974

The estimated regression equation is as follows:

$$\begin{aligned}
 P_{j,t} = & 0.9439 + 1.0191 \text{ PUS}_t - 0.8235 \text{ RD}_2 - 1.4750 \text{ RD}_3 & (5.8a) \\
 & (0.794) \quad (48.802) \quad (-0.903) \quad (-1.618) \\
 & - 2.7829 \text{ RD}_4 - 3.2993 \text{ RD}_5 - 7.3594 \text{ RD}_6 - 3.9233 \text{ RD}_7 \\
 & (-3.053) \quad (-3.619) \quad (-8.073) \quad (-4.304) \\
 & - 2.8274 \text{ RD}_8 - 3.1410 \text{ RD}_9 - 1.3690 \text{ RD}_{10} \\
 & (-3.101) \quad (-3.445) \quad (-1.502) \\
 R^2 = & 0.9845 \quad d.f. = 39 \quad D.W. = 1.6085
 \end{aligned}$$

Step 3. Calculate regional price estimates ($P_{j,t}$) for each year prior to 1975 based on the parameter estimates for the regression and the published national average price for each year.

Step 4. Proceed as in Step 2, parts ii through iv, of the basic imputation procedure for the period 1975 through 1980 described above.

5.2.4 Commercial Sector

Since the EIA-9A series data include some regional average prices for a combined commercial and industrial sector, it was proposed in the draft working paper on the distillate fuel price series to utilize such data for imputing state-level distillate prices for both the industrial and commercial sectors. Due to its length, the discussion of this initially proposed approach is included in Section 5.5, instead of as a footnote. Attempts to implement the proposed approach encountered substantial difficulties, especially for the commercial sector prices, which were calculated as the residuals of the data from the EIA-9A series. Consequently, a simple substitute approach was adopted.

The basic assumption made is that the apparent percentage markup in the sales of No. 2 distillate heating oils to commercial customers is a constant proportion of the apparent markup in sales to the residential customers. Given this assumption, the following steps are included in the imputation procedure for the commercial sector prices:

Step 1. Determine the average state ratios of the commercial apparent markup^(a) to that of the residential sector using available data in Foster Associates' Energy Prices.

$$ARAMXX = \frac{1}{3} \sum_{t=70}^{72} \left[\frac{(\text{PCM}(\text{FOSXX})_t \cdot \text{PLXX}_t) - 1.0}{(\text{PRS}(\text{FOSXX})_t \cdot \text{PLXX}_t) - 1.0} \right] \quad (5.9)$$

Where:

ARAMXX = average ratio of commercial markups to residential markups for state XX from Foster's

PCM(FOSXX)_t = commercial sector price for state XX in year t from Foster's

PRS(FOSXX)_t = residential sector price for state XX in year t from Foster's

PLXX_t = refinery/terminal prices for state XX in year t from Platt's

t = 1970, 1971, 1972

Step 2. Apply the ratios for individual years during 1970-1972 (RAMXX_t) and the average ratios for the period to the residential sector prices derived in Section 5.2.3 above and to the Platt's prices to compute commercial sector prices.

1970-1972

$$\text{PCMXX}_t = \text{PLXX}_t \cdot (1.0 + \text{RAMXX}_t \cdot (\text{PRSXX}_t \cdot \text{PLXX}_t) - 1.0) \quad (5.10)$$

This can be simplified to:

$$\text{PCMXX}_t = \text{PLXX}_t + \text{RAMXX}_t \cdot (\text{PRSXX}_t - \text{PLXX}_t) \quad (5.10a)$$

1973-1980

$$\text{PCMXX}_t = \text{PLXX}_t + \text{ARAMXX} \cdot (\text{PRSXX}_t - \text{PLXX}_t) \quad (5.11)$$

(a) Apparent markup is the ratio of the retail price to the terminal price minus 100 percent.

Where:

$PCMXX_t$ = commercial sector price for state XX in year t

$RAMXX_t$ = ratio of commercial markup to residential markup in state XX in year t from Foster's

$PRSXX_t$ = residential sector price for state XX in year t from Section 5.2.3

5.2.5 Industrial Sector

Although the ASM/CM data for the manufacturing sector were initially excluded from use in the data base development because of excess time lag in availability, difficulties in deriving industrial sector prices for distillate fuels utilizing the EIA-9A series data led to a reconsideration of the Annual Survey of Manufactures and Census of Manufactures (ASM/CM) data.

These data contain total distillate fuel use and costs by state for total manufacturing and by 2-digit SIC code for 1971, and 1974 through 1979. Data for subsequent years will also become available. However, the publishing time lag for the data has been substantial, often 2 to 3 years. This was the main reason that use of this source was not initially recommended. Another reason was that the data cover a narrowly defined manufacturing sector, instead of the more broadly defined industrial sector which includes agriculture, mining, and construction in addition to manufacturing.

The difficulties mentioned above led to a re-evaluation of this data source. First, the narrower definition of the industrial sector (i.e., manufacturing) can be an asset rather than a liability. Because the national economic and income accounts use the narrower industrial sector definition of manufacturing, use of the ASM/CM data would make it easier to integrate the national energy accounts with the national economic accounts. The basic vagueness of the "industrial sector" concept as compared to the "manufacturing sector" which includes industries SIC 20 through SIC 39, necessitate the use of the ASM/CM data in any attempt to integrate national energy and economic accounts.

Second, the lag in publication of the price data for the more recent years can be dealt with by adopting a procedure for deriving preliminary estimates

which are replaced by final estimates when they become available. This procedure will generate price data for years for which the ASM/CM are not yet published.

The following steps are involved in deriving a complete series of state level industrial sector distillate fuel prices from ASM/CM:

- Step 1. Divide total manufacturing sector consumption of distillate fuels from ASM/CM for each state into the corresponding total cost to calculate average price for state XX, in year t ($PINXX_t$) and convert to cents per gallon.
- Step 2. Estimate the following equation by regression linking residential sector data with industrial sector data, using pooled cross-section and time-series industrial sector data available for the years, 1971 and 1974 through 1979 for all 50 states and the District of Columbia:

$$\begin{aligned}
 PINXX_t = & a + b \cdot PRSUS_t + \sum_{j=2}^{10} c_j \cdot DJ_j + \sum_{XX=1}^{19} d_{XX} \cdot DSXX \\
 & + \sum_{XX=21}^{51} d_{XX} \cdot DSXX + \sum_{j=2}^{10} f_j \cdot (PRSUS_t \cdot DJ_j) \\
 & + \sum_{XX=1}^{19} g_{XX} \cdot (PRSUS_t \cdot DSXX) + \sum_{XX=21}^{51} g_{XX} \cdot (PRSUS_t \cdot DSXX) + k \cdot DYEAR
 \end{aligned} \tag{5.12}$$

Where:

$PRSUS_t$ = average U. S. residential distillate price in year t

DJ_j = dummy variable for DOE Region j; Region 1 is treated as the reference region and is not included.

$DSXX$ = dummy variable for state XX; State 20, Massachusetts, was treated as the reference state and is not included.

$DYEAR$ = dummy variable for time; 1.0 for 1974 and 0.0 for subsequent years.

Equation 5.12 is shown in the general form allowing for both state and regional variation in the parameter estimates for a and b. In the actual regression runs, variation of the equation form was tried. When the terms including the composite variables, $PRSUS_t \cdot DJ_j$ and $PRSUS_t \cdot DSXX$, are dropped, the c_j and d_{XX} reflect the variation of the intercept term a, due to state and regional differences, while the estimate for the "slope" term, b, is held constant for all states. When the dummy variables DJ_j and $DSXX$ are dropped from the equation, changes in the estimate for b are permitted through the coefficient estimates of f_j and g_{XX} , while holding constant the intercept term, a. These options were explored in fitting the equation to the data.

In actual regression runs, the interaction terms were dropped. Data for average U.S. residential distillate prices, $PRSUS_t$, is taken from the EIA Annual Report to Congress 1980. The estimated regression equation is as follows:

$$\begin{aligned}
 PINXX_t = & \frac{-1.3684}{(-3.492)} + \frac{0.3321}{(29.882)} PRSUS_t + \frac{2.0445}{(7.191)} DYEAR + \sum_{j=2}^{10} c_j \cdot DJ_j \\
 & + \sum_{XX=1}^{19} d_{XX} \cdot DSXX + \sum_{XX=21}^{51} d_{XX} \cdot DSXX
 \end{aligned} \tag{5.12a}$$

$$R^2 = 0.9735 \quad d.f. = 280 \quad D.W. = 1.693$$

The estimates for coefficients c_j and d_{XX} and their associated t-values are shown in Table 5.7.

- Step 3. Using the parameters of the linkage equation described in Step 2 above, impute for missing data in the industrial sector series derived from ASM/CM for the years 1971, and 1974-1979.
- Step 4. Compute the ratios of the prices derived above in Step 1 through Step 3 over Platt's refinery and terminal prices for each state for the years

TABLE 5.7. Estimated values of c_j and d_{xx} for Equation 5.12a

DOE Region j	c_j	t	DOE Region j	c_j	t
2	-0.0400	-0.0866	6	-0.6643	-1.4374
3	0.0114	0.0247	7	-0.7343	-1.5889
4	-0.5386	-1.1654	8	-1.8614	-4.0278
5	-0.1429	-0.3091	9	-0.6700	-1.4498
			10	-0.8943	-1.9351

State xx	d_{xx}	t	State xx	d_{xx}	t
AK	2.8757	6.2225	MO	0.5429	1.1746
AL	-0.4086	-0.8841	MS	-0.5571	-1.2056
AR	-0.5300	-1.1468	MT	1.8100	3.9165
AZ	-0.2943	-0.6368	NC	0.0043	0.0093
CT	0.0129	0.0278	ND	3.1029	6.7140
DC	1.8196	3.0401	NH	-0.2300	-0.4977
DE	-0.6471	-1.4003	NJ	-0.1414	-0.3060
FL	-0.1714	-0.3709	NM	2.5916	3.7164
GA	-0.5414	-1.1716	NV	1.0873	1.5592
HI	-0.0957	-0.2071	OH	1.0873	1.5592
IA	0.1657	0.3586	OK	0.2266	0.3250
ID	1.2043	2.6059	OR	0.8157	1.7651
IL	0.1071	0.2318	PA	-0.1643	-0.3555
IN	-0.3914	-0.8470	RI	-0.1514	-0.3277
KS	-0.2571	-0.5564	SC	-0.1271	-0.2751
KY	0.3400	0.7357	SD	2.5643	5.5487
LA	-2.1014	-4.5471	VT	1.0100	5.5487
MD	-0.0886	-0.1917	VA	-0.7986	-1.7280
ME	-0.2286	-0.4946	VT	0.4414	0.9552
MI	-0.2186	-0.4730	WY	3.3337	4.7806
MN	0.1943	0.4202			

1971 and 1974 through 1979. Also calculate the average ratios for the period 1974 through 1979.

Step 5. Apply the 1971 ratios derived in Step 4 to the years 1970, 1972, and 1973 of the corresponding Platt's data prices to estimate the industrial sector prices for those years. Similarly, apply the average ratios for the 1974 through 1979 period to the Platt's price for 1980 to derive preliminary estimates for that year.^(a) Note that the estimates for 1979 and 1980 are preliminary in the sense that they will be replaced when ASM data become available.

5.3 RECOMMENDATIONS

It is clear from the previous section that there is no one single data source that is comprehensive enough to provide the desired distillate fuel price series for the residential, commercial, industrial, and electric utility sectors. Such a state price series must be pieced together from several different data sources. Furthermore, since existing data sources are subject to various gaps and shortcomings, it is necessary to adopt imputation procedures for the prices desired for some sectors and some states. In this section, we set forth our recommendations concerning the set of data sources and the procedures for imputation for the four sectors. Related recommendations on data processing and design of data collection forms are also included.

5.3.1 Residential Sector

We recommend that the data collected from the EIA-9A sources be used directly for the state residential fuel prices wherever possible. Where necessary, this will be supplemented by Platt's data using the procedure discussed above. For periods for which there are no EIA data, overall U.S. average prices will be used in conjunction with Platt's data to impute state prices.

(a) Steps (4) and (5) represent changes from the proposed procedures in the draft working paper. It was proposed to apply the estimated regression equation to all years. However, this approach performed badly in estimation beyond the data period. As a result, Steps (4) and (5) were implemented.

5.3.2 Industrial Sector

Since it was not possible to separate the regional average prices for the combined commercial/industrial sector in the EIA-9A data without resorting to arbitrary assumptions and assignment of ratios, we recommended the direct use of the price data from ASM and CM for the years when the data are available. Missing data points for the data period would be filled by the procedure described in Steps (1) through (3) for the industrial sector above. Data for the earlier years (1970, 1972-1973) can be derived from Platt's prices using the estimated 1971 ratios. Moreover, because ASM has substantial time lags to publication, a simple linkage procedure was developed for deriving preliminary estimates for use in the recent years. As the data from ASM are published, they will replace the preliminary estimates. This procedure was described in Steps (4) and (5).

5.3.3 Commercial Sector

It is recommended that commercial sector prices be linked to the residential sector prices under the assumption that apparent percentage markups in the commercial sector are a constant ratio of apparent percentage markups in the residential sector. The average ratios for individual states derived from Foster Associates for 1970-1972 are used.

5.3.4 Electric Utility Sector

It is recommended that data on state average delivered cost of distillate fuel to electric utilities contained in EIA's Cost and Quality of Fuels for Electric Utility Plants be used for the electric utility sector. This is consistent with recommendations regarding development of state-level utility sector prices for all other fuels. This data source covers the time period from 1973 to the present. For the 1970-1972 period and for states lacking 1973 data, the EEI Statistical Year Book data can be used to construct the time series based on the relationship shown in Equation 5.1.

5.3.5 Related Recommendations

Several related recommendations developed from our critical review of the EIA-9A and EIA-9 data sources. First, it is recommended that current data processing procedures be modified so that average annual prices and gross

margins at national, regional, and state levels are routinely computed and published. Since many users and potential users of the price data are interested in the annual average prices and margins, the absence of both annual data and relevant monthly weights is likely to lead to use of simple averages which create systematic bias in the estimation of absolute prices.

Second, consideration should be given to releasing information on monthly usage patterns at the national, regional, and state levels. Such information is important in the analysis of seasonal usage patterns and the impacts of weather fluctuations and other short- or long-term disturbances. It may prove particularly useful in contingency planning.

Third, since the sectoral classification of "commercial" and "industrial" sectors is in widespread use, the benefits and costs of changing the EIA-9A source form so that the prices for commercial and industrial sectors can be directly calculated should be carefully analyzed. If there are substantial benefits from the segregation of the two sectors and the increases in respondents' burdens are slight, then the EIA-9A form should be redesigned.

5.4 SUMMARY OF AGENCY COMMENTS

Formal EIA review of the draft working paper for distillate price series raised issues such as those on the strictness of the data base review criteria and on concerns about publication of the data base developed. These have been dealt with in earlier chapters. In addition, the following points were also raised:

1. It was mentioned that EIA-9A data include all sales to end users, regardless of use. Specifically, the sectoral ambiguity arising from the case of commercial customers buying No. 2 fuel oil for heating purposes and No. 2 diesel for commercial fleets was pointed out. The need for separating a transportation use category was noted.

Response: As stated in the working paper, motor gasoline and diesel fuel were dealt with in separate working papers. Both of these price series are attributed to the transportation sector. They are covered in Chapters 6 and 7 in this volume.

2. It was pointed out that the imputation procedures proposed in the working paper showed strong dependence on the Platt's data. Since the

Platt's data overlaps with EIA-9A data, it was suggested that comparison be made of the overlapping data. It was also mentioned that Platt's prices were terminal and refinery prices for a city and, therefore, might not accurately reflect state average prices. It was also suggested that unpublished EIA estimates of EIA-9A state data be used.

Response: In developing the state-level distillate prices for the residential sector, we relied as much as possible on published EIA data from EIA-9A. For those years when regional prices are available for EIA-9A and its predecessor forms, the use of Platt's data to impute state-level prices was made subject to the EIA-9A regional prices. If the EIA-9A regional average prices accurately reflect the state-level prices, then the imputed prices have been corrected for the divergence between state average and Platt's city prices. (See Section 5.2.3) Similarly, imputed prices for earlier years are also dependent upon the EIA-9A regional prices to some extent through the use of Equation 5.8a. In the industrial sector, the Platt's data are subject to the constraint of the observed prices from the Annual Survey of Manufactures.

It was initially planned that the unpublished EIA-9A monthly quantities were to be used as weights in calculating the average annual prices for each state and region. However, difficulties in extracting and processing the data led to the substitution of the normal monthly heating-degree-day data for that purpose. Furthermore, direct use of other formerly unpublished price data, if available, is not feasible unless documentation is separately prepared.

The suggestion for comparative analysis of Platt's data and EIA-9A data is useful. It is being included in one of the recommendations.

5.5 NOTES ON EARLIER APPROACHES TO IMPUTING INDUSTRIAL AND COMMERCIAL SECTOR PRICES

Since the EIA-9A series data include some regional average prices for a combined commercial and industrial sector, such data hold potential for imputing state-level distillate prices for both the industrial and commercial

sectors. For this reason, we had considered, in the draft working paper, three options for deriving state-level distillate prices for the industrial sector. These are explained in this subsection. Option 1 accepts the data from EIA-9A as they are without further processing. Option 2 attempts to separate the commercial prices and industrial prices by certain assumptions and assignment of arbitrary numerical ratios. Option 3 depends on additional estimates of industrial sector prices and utilizes all of the information contained in the EIA-9A series.

Although eventually none of the three options was used for the commercial sector imputation, the discussion is relevant to the data base development process. Since this discussion is rather lengthy, the usual format of adding a footnote is replaced by the addition of this section.

Option 1. The simplest option is to assign the regional average prices for the combined commercial/industrial sector from the EIA-9A series to all the individual states within each region for the commercial and industrial sectors separately. For years in which data are available from the source, this option is straightforward. However, it suffers from the following drawbacks: 1) Since the original data source combines the industrial and commercial sectors, any price differences between these two sectors are disregarded; 2) Intra-regional variations in prices are not reflected; and 3) Since the EIA data on combined commercial/industrial prices go back only to 1975, prices for earlier years would have to be imputed in some manner.

Option 2. The second option attempts to separate the commercial average prices from the industrial average prices by considering the relationships between residential, commercial, industrial, combined commercial/industrial, and electric utility sector prices. It is generally true that the average quantity consumed per customer is smallest in the residential sector. The second smallest volume transactions occur in the commercial sector. The quantities consumed in the industrial sector and the electric utilities are generally larger than the commercial sector but the relative magnitudes of consumption between the industrial and electric utility sectors is unknown. For the purpose of this discussion, it is assumed that the transaction volume involved in the electric utility sector is, on the average, larger than that in the industrial sector.

Since the quantity discount will be larger and the cost of delivery smaller for a larger volume transaction, prices for sectors with larger transaction volumes would tend to be lower. There is, therefore, a hierarchical relationship among distillate prices for the different sectors: Residential sector (PR), commercial sector (PC), combined commercial/industrial sector (PIC), industrial sector (PI), and electric utility sector (PE).

If the quantity shares of industrial sales and commercial sales making up the combined industrial/commercial sector sales were known, then the relationship between the combined price and the individual industrial and commercial sector prices could be calculated:

$$PIC = (SW_I \div SW_{IC}) PI + (SW_C \div SW_{IC}) PC \quad (5.13)$$

where $SW_I \div SW_{IC}$ and $SW_C \div SW_{IC}$ are respectively the quantity shares of the volumes consumed in the industrial sector and the commercial sector within the combined sector.

Since data for PE, PR, and PIC are available and the PI and PC are unknown, the problem is to approximate PI and PC from the known prices and their relationships. From Equation 5.13, we have the following relationships:^(a)

$$PC = (SW_{IC} \div SW_C) PIC + (SW_I \div SW_C) PI \quad (5.14)$$

$$PI = (SW_{IC} \div SW_I) PIC + (SW_C \div SW_I) PC \quad (5.15)$$

To estimate commercial and industrial sector prices we can estimate values for the difference between PC and PIC as well as between PIC and PI and use these to adjust the data for the combined sector, PIC. Since (PR - PE) is known, the adjustment factor can be defined as: $(1 \div n)(PR - PE)$, where n is a

(a) Note that the definitional equality, $(SW_I \div SW_{IC}) + (SW_C \div SW_{IC}) = 1.0$, is utilized in the derivation of Equations 5.14 and 5.15 from Equation 5.13.

positive integer, greater than 1.^(b) If it is assumed that (PR - PC) equals (PI - PE) as well as (PC - PI) then n = 3 and the following approximations become possible:

$$PC = PIC + \frac{1}{2} \cdot \frac{1}{3} (PR - PE) \quad (5.16)$$

$$PI = PIC - \frac{1}{2} \cdot \frac{1}{3} (PR - PE) \quad (5.17)$$

Given estimated regional prices for the industrial sector and commercial sector, PI and PC, the same imputation procedure based on Platt's data explained above for the residential sector can then be used to generate the state-level prices, thus avoiding drawbacks 1) and 2) of Option 1. However, Option 2 also presents several difficulties: 1) The assignment of the ratio (1/3) or any other ratio in Option 2 is quite arbitrary; and 2) This approach requires that all the relevant prices for the residential and electric utilities are known. Any missing prices for these two sectors will have to be imputed first.

Option 3. The third option uses independent estimates of average state-level distillate fuel prices for the industrial sector and as well as the information on regional average prices for the combined commercial/industrial sector to derive regional average prices for the commercial sector. These are in turn used to generate state-level prices for the commercial sector. The independent data sources for the industrial sector are the Bureau of the Census Census of Manufactures (CM) and Annual Survey of Manufactures (ASM).

The utilization of the ASM/CM data for the industrial sector follows the procedure described in Subsection 5.2.5 above. After the industrial sector prices are derived, the following steps are necessary to derive the commercial sector prices:

-
- (b) If n approaches 1.0, the imputed PC may become higher than PR and the imputed PI lower than PE, contradicting the initial assumptions. As n is assigned increasingly larger values, the difference between commercial sector prices and industrial sector prices becomes increasingly small and the result of Option 2 approaches that of Option 1.

Step 1. Compute the volume-weighted regional average industrial prices as follows:

$$PIN_{j,t} = \sum_{XX=1}^{n_j} (SVXX_{j,t} \div SV_{j,t}) PIXX_{j,t} \quad (5.18)$$

Where:

$SVXX_{j,t}$ = quantity of use in the industrial sector in state XX, in region j, in year t from SEDS

$SV_{j,t}$ = quantity of distillate fuels used in the industrial sector in region j, in year t, from SEDS

Step 2. Calculate the regional average commercial sector price for distillate fuel from the industrial and combined sector prices:

$$PC_{j,t} = (SVIC_{j,t} \div SVC_{j,t}) PIC_{j,t} - (SVI_{j,t} \div SVIC_{j,t}) PI_{j,t} \quad (5.19)$$

where $SVI_{j,t}$ and $SVC_{j,t}$ are, respectively, industrial and commercial quantities for region j, $SVIC_{j,t}$ is the quantity for the combined sectors and the $PIC_{j,t}$ are the average regional prices for the combined industrial/commercial sector from the EIA-9A series.

Step 3. State-level distillate prices for the commercial sector are generated by linkage to the residential prices reported in the EIA-9A sources or developed by the methods discussed in the previous section, subject to the constraint of the average regional prices for the commercial sector calculated above. This involves the following steps:

- i. Regional average residential prices with commercial sector weights, $(PRC_{j,t})$ are first calculated using the individual states' quantities of commercial use of distillate fuels, $(SVCXX_{j,t})$ from SEDS.

$$PRC_{j,t} = \sum_{XX=1}^{n_j} PRXX_{j,t} (SVCXX_{j,t} \div \sum_{XX=1}^{n_j} SVCXX_{j,t}) \quad (5.20)$$

Where:

$PRXX_{j,t}$ = distillate residential price for state XX in region j in year t

- ii. A commercial price adjustment factor for each region, $(BC_{j,t})$, is then computed as the ratio of the calculated regional average commercial price, $(PC_{j,t})$, and the regional average residential price with commercial weights:

$$BC_{j,t} = PC_{j,t} \div PRC_{j,t} \quad (5.21)$$

- iii. Finally the state-level commercial prices are computed by adjusting the state-level residential price with the adjustment factor derived above:

$$PCXX_{j,t} = BC_{j,t} \cdot PRXX_{j,t} \quad (5.22)$$

- iv. For the earlier years when there were no regional average prices for the combined commercial/industrial sector, average adjustment factors would be used:

$$PCXX_{j,t} = BAC_j \cdot PRXX_{j,t} \quad (5.23)$$

Where:

BAC_j = simple average of the $BC_{j,t}$ calculated above for 1975 through 1980.

6. MOTOR GASOLINE

Motor gasoline is a naphtha-type petroleum product of which various grades are produced for use in internal combustion engines. Gasoline is usually classified by grade and by type. Regular grade gasoline has an antiknock designation of 2 for unleaded and 3 for leaded products. Premium leaded gasoline has an antiknock designation of 5, while the designation for the unleaded product is slightly lower. In 1980, unleaded gasoline of both grades accounted for nearly half of the gasoline used in the U.S.

Available data sources define the prices of motor gasoline by grade (regular, premium) and by type (leaded, unleaded). Retail prices (usually called pump or service station prices) vary by the type of service (full-serve, mini-serve, self-serve), and by inclusion or exclusion of taxes (federal, state, local). The gasoline price series developed for inclusion in the STEPS would, ideally, contain the average retail prices, inclusive of all taxes, that are volume-weighted by grade and type of gasoline, and by type of service.

Although motor gasoline is consumed in all five economic sectors covered in this study, it is predominantly used in the transportation sector which includes residential transportation. In this study, the convention of treating motor gasoline as entirely covered by the transportation sector is followed. There is, therefore, only one price series for motor gasoline. In 1979, motor gasoline supplied an estimated 13.5 Quads of energy to the total U. S. consumption of 79 Quads, (17 percent). The transportation sector accounted for 98 percent of the energy supplied by motor gasoline, while the other sectors combined accounted for the other 2 percent.

6.1 DATA BASE REVIEW

A working list of published sources of gasoline prices was compiled from: The American Gas Association's Energy Statistics: North American and World Sources, 1977; the Ideamatics, Inc. report, Federal Energy Data System Analysis and Evaluation, 1978; the Energy Information Administration's EIA Publications

Directory, 1980; and a search of bibliographies of energy-related publications. Preliminary examination of the identified sources of motor gasoline price data narrowed the field of candidate data bases to eight that met or nearly met the established review criteria. Of the eight candidate data bases, listed in Table 6.1, the EIA series, the two series used by McGraw-Hill, Inc. in Platt's Oil Price Handbook and Oilmanac, and the Consumer Price Index data came closest to satisfying the specified requirements, although no single series did so. The remaining four gasoline price data bases failed to meet review criteria or definitional requirements making them less suitable for EIA use (see Table 6.2).

The most comprehensive price series identified was that collected on EIA Form 79, "Monthly Motor Gasoline Service Station Survey." EIA-79 collected the monthly sales volume in gallons and the posted pump price on the fifteenth day of the month for leaded regular, leaded premium, unleaded regular, and unleaded premium gasoline. Each of these price categories was further stratified by type of service (full-serve, mini-serve, self-serve). Volume-weighted, state-level prices were estimated by the EIA but were never published; the EIA-79

TABLE 6.1. Candidate Sources of Motor Gasoline Price Data

<u>Organization</u>	<u>Price Data Source</u>
Energy Information Administration	Form EIA-79, EIA-8
Lundberg Survey, Inc.	"Platts/Lundberg Summary"
Lundberg Survey - McGraw Hill	"Dealer and S.S. Average Prices: Gasoline"
Bureau of Labor Statistics	<u>Consumer Prices: Energy</u>
USDA Crop, Reporting Board	<u>Agricultural Prices</u>
Bureau of Labor Statistics	<u>Producer Prices and Price Indexes</u>
Pennwell Publishing Co.	<u>Oil and Gas Journal</u>
Oil Daily, Inc.	<u>Oil Daily</u>

TABLE 6.2. Comparison of Candidate Gasoline Price Data Bases

Characteristic	EIA-79	"Platt's Lundberg Summary"	"Dealer & S.S. Price Averages Gasoline"	CPI	Agricultural Prices	PPI	Oil and Gas Journal	Oil Daily
Adequate data for state level estimates	+	-	+	-	+	-	-	-
Timely availability of data	+	+	+	+	+	+	+	+
Minimal imputation of missing data	+	+	+	+	+	+	0	0
Documentable methodology	+	+	+	+	+	+	-	-
Comprehensive and consistent series	+	+	+	+	+	+	0	0

+: Yes or available
 -: No or unavailable
 0: Unknown

data were published by DOE Region in an EIA report entitled Gasoline Prices, and were used to develop national monthly average gasoline prices in the Monthly Energy Review. The lag to publication of Gasoline Prices, which contained prices from EIA-79 alone, was three months.

Submission of Form EIA-79 was required of 8000 service stations in the randomly selected sample. The EIA used selective audits to validate the prices collected, and no prices were imputed. Although a high-quality source of gasoline data, EIA-79 was too short-lived to serve as the sole source of a price series. Beginning in January 1978, data collection for EIA-79 continued only through June 1980, and as of the writing of this paper the EIA had no plans to replace the form. A predecessor, Form EIA-8, was used from May 1977 through December 1977; however, the data for that period are no longer available.

The "Platt's/Lundberg Summary," which was compiled by the Lundberg Survey for McGraw-Hill, was published in both the Lundberg Letter and Platt's Oil Price Handbook and Oilmanac. Monthly, Lundberg field agents gathered posted pump prices, including taxes, for each of the randomly chosen 14,000 retail service stations sampled. In the "Platt's/Lundberg Summary" tables, retail prices were reported by type and grade of gasoline, and by type of service (full-serve, self-serve); wholesale prices and margins were also presented. There have been no missing data in the history of the series, and prices were validated by supervisors who oversee the field agents.

The gasoline price data reported in the "Platt's/Lundberg Summary" include both monthly and annual average prices. The monthly prices were straight averages of a minimum of 150 price quotes gathered for a specific metropolitan area on one day of the reporting month. The annual price data were called "volume-weighted" prices, but the volume-weighting procedure matches state volumes with city prices as follows: For each city, every month, the monthly average price was multiplied by the monthly volume of gasoline sold in the state in which the city is located. (The volume data were obtained from Ethyl Corporation or Department of Transportation publications). The monthly products were then summed for the year and divided by the state's annual total

volume of gasoline sold. The resultant figure was then reported as a volume-weighted, annual average price.

The "Platt's/Lundberg Summary" had a shortcoming in its coverage of the United States. The 48 cities for which data were published were located in only 33 states and the District of Columbia, and most of the states represented had only one city price quote from which to generate a state-level price estimate. Like EIA-79, the "Platt's/Lundberg Summary" was relatively short-lived, running from January 1979 through March 1981, when the Lundberg and McGraw-Hill contract was terminated. Since that time EIA has contracted directly with Lundberg for collection of gasoline data for 90 cities, with prices reported by DOE Region.

Before the 1979 edition, Platt's Oil Price Handbook Oilmanac published its gasoline prices in a table titled, "Dealer & S.S. Price Averages: Gasoline." This table was the source the EIA had been using for its gasoline price data base. The Lundberg Survey was the major contributor to this series also, and there is similarity between the "Dealer & S.S." and the "Platt's/Lundberg Summary" price series. However, the coverage of the former was more extensive than that of the latter, as the "Dealer & S.S." table reported data for 55 cities which covered all 48 of the contiguous states. The prices in "Dealer & S.S." were simple averages of regular, leaded gasoline prices, with no stratification by type of service. Prices were reported both including and excluding taxes. Collection methods and validation procedures for "Dealer & S.S. Price Averages: Gasoline" were similar to those described for the "Platt's/Lundberg Summary." Consistent and comparable data for "Dealer & S.S." are available back to 1955 through the Lundberg Survey. Even though the table "Dealer & S.S." was discontinued by Platt's in 1978, the "Platt's/Lundberg Summary" continued to gather comparable data so extension of this series is possible. The lag to publication of the monthly data was less than one month.

The Bureau of Labor Statistics (BLS) collects gasoline price data that are published in Consumer Prices: Energy. Pump prices are collected by BLS field agents for leaded regular, leaded premium, and unleaded regular, with each price category containing quotes for full-serve, mini-serve, and self-serve pumps. The sample is composed of retail service stations that serve households participating in the Consumer Price Index (CPI) survey. Service

stations are periodically rotated in and out of the sample. Prior to 1978, BLS collected price data in 56 Standard Metropolitan Statistical Areas (SMSA); in 1978 the survey was expanded to cover 85 SMSAs. Only regional averages and data from 28 of the larger SMSAs are published, with a publication lag of about three weeks.

Except for the increase in sample size, the CPI data is consistent back to 1973, when the weighting procedure changed. The current price weighting procedure is a complex combination of sales volume percentages and population-linked weights. Collected data are carefully validated and missing data are marked "not available." Although the 1978 expansion of the sample size did little to increase the number of states covered, for several states it did increase the number of city prices reported. The 56 cities series covered 35 states and the District of Columbia, while the 85 cities series covers 39 states and the District of Columbia.

As seen in Table 6.2, Agricultural Prices, produced by the Department of Agriculture's Crop Reporting Board, meets the review criteria. Prices are reported, including taxes, for service-station unleaded regular and bulk-delivery leaded regular. Respondents are asked to provide prices for the product most commonly purchased by farm families or the product with the largest sales volume. The survey is somewhat lacking in consistency across states because each state handles distribution and collection of the form used ("Prices Paid by Farmers for Petroleum Products," OMB #40-R 1906) separately, and because each respondent makes the decision about which type of fuel to report as "commonly purchased." Information on sales volumes is not collected.

The remaining three candidate gasoline price data bases -- Oil and Gas Journal, Oil Daily, and Producer Prices and Price Indexes -- were examined and determined to be unsuitable for EIA use. Neither Pennwell Publishing Company nor Oil Daily, Inc. would disclose the methodologies used to generate the gasoline price series published in Oil and Gas Journal and the Oil Daily. The Oil and Gas Journal price data are generally recognized by industry as reliable gasoline prices and are gathered through telephone surveys of five or six major brand companies who quote prices for 52 cities. Prices collected are wholesale; the reported retail prices are estimated from the wholesale price movements. Pennwell staff were unable or unwilling to describe this estimation

procedure in any detail. Oil Daily also publishes retail prices estimates derived from wholesale prices at the city level. Once a week, dealer tank wagon and pump prices, excluding taxes, are reported for 50 cities. No information about the data collection methods or the estimation procedures used by Oil Daily, Inc. was available.

The Bureau of Labor Statistics' Producer Prices and Price Indexes gasoline price data meet most of the review criteria, but coverage is insufficient for calculation of state-level estimates. Data are collected from 28 major refiners who voluntarily report wholesale prices for sales to commercial consumers of regular leaded, premium leaded, and regular unleaded gasoline. The collected data are aggregated and published by census region. Since no retail price estimates are generated and no aggregation level lower than census region is available, Producer Prices and Price Indexes data are not directly usable for EIA purposes.

6.2 PRICE COMPUTATION AND IMPUTATION PROCEDURES

There are several data bases available for imputing a state-level gasoline price series, though no one data source alone is sufficient. The Agricultural Prices data, though meeting the minimum requirement for developing a state-level gasoline price series for a separate agriculture sector, are not broadly based. Since agriculture is lumped into the "industrial" sector in this project, it is our judgment that this data base is probably not compatible with the other available data bases. For this reason, the imputation procedures discussed below are based on use of the Bureau of Labor Statistics (BLS) and Platt's data. This approach is consistent with EIA development of annual average national gasoline prices published in the Annual Report to Congress.

Due to characteristics of these data bases, the period under consideration (from 1970 onward), is separated into two sub-periods depending on data availability: the year 1973 and earlier, and the period beginning in 1974. Before June 1973, the only available city or region-specific gasoline prices at the retail and wholesale levels are from Platt's Oil Price and Oilmanac.

Since June 1973, BLS has been collecting and releasing retail gasoline prices for major metropolitan areas, Census Regions and the nation.

The most important aspects of the data used in the imputation are shown in Table 6.3. The first three series listed are essentially the same Platt's retail price data set but differ to some extent in sample size, price and product definitions, and price computation procedure. While Platt's personnel indicated that a 55-city survey was reinstated in 1981, details were unavailable. The fourth series is also from Platt's but is a wholesale rather than retail price series.

The BLS data are listed as one series because methods and definitions are relatively consistent over time. As noted, this series started in July 1973. Because there are only six months of published data for 1973, these data are not used in developing the price series. In 1978, there was a major sample size increase and resulting increase in published data. Unpublished data from this series are not available from BLS for years prior to 1976 and only 20 months of data are available for 1976 and 1977. All of the unpublished data since 1978 are available within BLS.

The EIA-79 data covers all states but the sample size is insufficient to support publication of state-level price estimates. In addition, the survey had a very short life. The monthly surveys were conducted for January 1978 through June 1980. These facts prevent use of the EIA-79 data except as a benchmark in the imputation process.

Volume data from Highway Statistics compiled by the U.S. Department of Transportation are used in the imputation procedure. Monthly volume data for all gasoline are available from this source.

6.2.1 Procedures For 1970 Through 1973

The imputation procedure suggested for this period relies upon the Platt's retail price data. Alaska and Hawaii are the only states for which data are missing and these states are also excluded from all of the other available data sets for this period.

Step 1. Assign monthly average price observations for cities or metropolitan areas to the states in which they lie.

TABLE 6.3. Detailed Characteristics of Motor Gasoline Price Data Bases

Series	Price Definition	Product Definition	Published Data	Unpublished Data	States Not Covered	Reporting Period	Computation Procedure
Platt's "Dealer & SS" 1970 - 1978	Retail including and excluding taxes; tank wagon	Regular leaded	55 cities covering 48 states	None	AK, HI	Monthly; annual	Averages of price quotes
Platt's/Lundberg Summary 1979 - 1980	Retail including taxes for full and self service; wholesale	Regular leaded; unleaded; premium leaded and unleaded	48 cities covering 34 states	None	AK, AR, DE, HI, KS, ME, MS, MT, ND, NH, OK, RI, SC, SD, VT, WV, WY	Monthly; annual	M-average of price quotes A-volume, weighted averages for each product type
Platt's 1981 on	Retail	NA	55 cities	None	NA	NA	NA
Platt's Terminal Prices 1971 on	F.O.B. terminal	Regular; premium; unleaded	34 cities covering 29 states	None	21 states	Monthly; annual	Averages of price quotes
BLS CPI 1974 on	Retail including taxes for full and self serve	Regular leaded; unleaded; premium leaded	Prior to 1978: 23 SMSA's; city average 1978 on: 28 SMSA's; Class A, B,C, and D areas in 4 Census Regions; City average	Prior to 1978: 33 cities 1978 on: 57 cities	Prior to 1978: AR, AZ, DE, ID, KY, MT, NE, NV, NH, NM, RI, SD, VT, WV, WY 1978 on: DE, ID, NV, NH, ND, OK, SD, VT, WY	Monthly; annual	Population weighted averages of price quotes
EIA - 79 1978 - 1980	Retail including taxes for full and self service	Regular leaded; unleaded; premium leaded and unleaded	DOE regions; nation	All states	None	Monthly	Volume weighted average prices
Agricultural Prices 1970 on	Retail including taxes for full and self service and bulk delivery	Regular leaded; unleaded	50 states	None	Prices in New England are regional	Monthly	Average of reported prices

Step 2. Where there is more than one data point per state, take the simple average of the observations to estimate the monthly state prices ($PXX_{t,m}$).

Step 3. Calculate volume-weighted annual state prices (PXX_t) by applying volume-weights for each month from the Highway Statistics data ($HSXX_{t,m}$) to the estimated monthly state prices ($PXX_{t,m}$).

$$PXX_t = \frac{\sum_{m=1}^{12} (PXX_{t,m} \cdot HSXX_{t,m})}{\sum_{m=1}^{12} HSXX_{t,m}} \quad (6.1)$$

Step 4. Impute prices for Alaska and Hawaii (PAK_t and PHI_t) based on the relationship of their annual state prices and a simple national average prices. For Hawaii, this relationship is estimated using data from 1974 to 1978; for Alaska, the estimation is based on data from 1978 and 1979.

- a. Calculate a simple national average price (PUS_t) for the years to be imputed and the years used for the estimation.

$$PUS_t = \frac{\sum_{XX=1}^N PXX_t}{N} \quad (6.2)$$

Where:

N = number of states for which data are available

PXX_t = annual price of gasoline for state XX in year t

- b. Estimate prices for Alaska and Hawaii:

$$PAK_s = PUS_t \left[\frac{\sum_{t=1}^n (PAK_t \div PUS_t)}{n} \right] \quad (6.3a)$$

$$PHI_s = PUS_s \left[\frac{\sum_{t=1}^n (PHI_t \div PUS_t)}{n} \right] \quad (6.3b)$$

Where:

s = years for which data need to be imputed

t = years on which the imputation is based

n = the number of years of data available for the imputation
(Hawaii, n = 5; Alaska, n = 2)

Step 5. Calculate the national average, volume-weighted price (PUS_t) by applying volume weights from SEDS ($SVXX_t$) to the state prices (PXX_t).

$$PUS_t = \frac{\sum_{XX=1}^{51} (PXX_t \cdot SVXX_t)}{\sum_{XX=1}^{51} SVXX_t} \quad (6.4)$$

6.2.2 Procedures For 1974 Through 1980

After 1974, the availability of price observations (based on a population-weighted sample) published by BLS allows for state price estimation from a larger data base than is the case for 1970 through 1973. As a result, Alaska is the only state not covered from 1974 through 1977. Due to the Platt's sample change in 1979, however, 14 states have missing data in 1979 and 1980 as shown in Table 6.3.

Step 1. Assign monthly price observations from Platt's and the CPI to the states within which the cities or SMSAs lie. If an SMSA lies across state boundaries, then the same price is assigned to all the states involved. If both Platt's and the CPI have prices for a city, the CPI data will be used.

Step 2. Where there is more than one data point per state, average the observations to estimate the state price ($PXX_{t,m}$).

Step 3. Where there are no data for a state in a given month, assign a state price ($PXX_{t,m}$) based on the relationship of EIA-79 data ($PEIAXX_{j,t,m}$) to published CPI regional data $PCEN_{j,t,m}$. (Data for available to estimate this relationship.)

$$PXX_{t,m} = PCEN_{j,t,m} \left[\frac{\sum_{m=1}^{12} (PEIAXX_{j,t,m} \div PCEN_{j,t,m})}{12} \right] \quad (6.5)$$

Where:

j = the region in which state XX lies

$PCEN_{j,t,m}$ = a simple average of regional prices for all city sizes for region j in year t , in month m from the CPI data for 1979

$PEIAXX_{t,m}$ = volume-weighted average of price observations for state XX in year t , in month m from the EIA-79 data for 1979

Step 4. Calculate volume-weighted annual state prices (PXX_t) by applying volume weights for each month from the Highway Statistics data ($HSXX_{t,m}$) to the monthly state prices ($PXX_{t,m}$) as in Equation 6.1.

Step 5. Calculate the national prices (PUS_t) as in Step 5.

6.2.3 Validation

Results of the imputation procedures may be evaluated by statistically testing for the probability that two samples are drawn from the same population. The two samples are the imputed monthly state prices for 1979 and the monthly volume-weighted average state prices that can be calculated from EIA-79 data for the same period.

6.3 RECOMMENDATIONS

Due to lack of any volume-weighted data from 1970 to 1980, it is recommended that development of a price series for gasoline be based on volume

weighting of monthly retail price observations at the city level. This can be accomplished using Platt's retail price data and published CPI SMSA data and, in a few cases, regional data. Unpublished data from the EIA-79 survey for 1979 can be used as a benchmark approximation of volume-weighted average state prices to support imputation of missing data.

6.4 SUMMARY OF AGENCY COMMENTS

Formal EIA review on the motor gasoline price series working paper generally concurred with the above recommendations. Two points were noted specifically:

1. The proposed imputation procedure requires the use of multiple data sources, each of which is to be used in one or two steps in the process. While the proposed process appears to be sound, the final price estimates could be "weakened" by the use of varied data sources.

Response: The use of multiple data sources was necessitated by the fact that none of the data sources was comprehensive enough to generate a motor gasoline price series of the scope, coverage, and consistency required for the data base. Although we recognized the possibility that the final price estimates could be weakened by this procedure we found that alternatives to the proposed procedure would tend to yield data bases that would not approximate as closely as would the proposed procedure, the requirements of the data base set forth for this project.

2. The totality of the criteria for evaluating the data sources appears to be "the ideal", rather than "the feasible". Better justifications are needed if those criteria are to be strictly adhered to.

Response: It was the project team's intention to use the data base criteria as the guidelines or "the ideal" to be approximated as closely as possible. Since no primary data collection was to be included as part of this project, "practicality" and "feasibility" were inputs to the formulation of the recommendations. In other words, although the data base review criteria no doubt exerted certain limiting influences in the data development process, they were not totally constraining. For more discussion of this subject, see Volume I, Chapter 2.

7. DIESEL

Diesel fuel is one of the distillate fuels of refined petroleum products. As a product category, it includes No. 1-D, No. 2-D, and No. 4-D diesel fuels and has a Btu content of about 140,000 Btu per gallon (5.88 million Btu per barrel). For the purpose of this report, diesel fuel will include only No. 1-D and No. 2-D diesel fuels because data for No. 4-D diesel fuel are unavailable. No. 1-D and 2-D diesel fuels constitute the largest share of diesel fuel consumption, and are approximately equal in price. In the continental United States, No. 1-D diesel fuel price usually exceeds No. 2-D diesel price by approximately \$.01 to \$.02 per gallon.

Diesel fuels are consumed in the transportation and industrial sectors. Users of diesel fuels include metropolitan transit systems, school districts, railroads, truckers, and households for the transportation sector, and farmers and heavy machinery users in the industrial sector. Published data sources usually include consumption of diesel fuels in total distillate use without disaggregation. It is, therefore, not possible to give any accurate order of magnitudes of the contribution of diesel fuels in the total energy picture as well as the relative share of diesel use by the transportation and industrial sector. Moreover, since industrial sector data are lacking and since it is plausible to assume that the transportation sector accounted for most of the consumption of diesel fuels, only a transportation sector price series is developed.

7.1 DATA BASE REVIEW

A list of published sources of diesel fuel prices was compiled from the American Gas Association's (AGA) Energy Statistics: North American and World Sources, 1977; the Ideamatics, Inc. report, Federal Energy Data System Analysis and Evaluation, 1978; the Energy Information Association's EIA Publications Directory, 1980; and a search of bibliographies of energy related publications. Preliminary examination of the identified sources determined that only five met, or nearly met, the established review criteria. These are listed in Table 7.1. Among the sources reviewed and determined unsuitable for EIA use were Annual Survey of Manufactures, Cost and Quality of Fuels for Electric Utility Plants, EI Statistical Year Book, Journal of Commerce,

TABLE 7.1. Candidate Sources of Diesel Price Data

<u>Organization</u>	<u>Publication</u>	<u>Forms Used</u>
U.S. Department of Agriculture	<u>Agricultural Prices</u>	OMB #40-R 1906
American Public Transit Association	<u>Quarterly No. 1 Diesel Fuel Price Report</u>	----
Bureau of Labor Statistics	<u>Producer Prices and Price Indexes</u>	----
McGraw Hill, Inc.	<u>Platt's Oil Price Handbook and Oilmanac</u>	----
Energy Information Administration	Unpublished	EIA-9A

Monthly Energy Review, Oil and Gas Journal, Oil Buyers Guide, Oil Daily, Oil Express, and Monthly Petroleum Product Price Report. Most of these price series were rejected either because they were not developed by primary data collection, or because diesel fuel prices were included with other fuel prices in a distillate price series and could not be disaggregated.

The five data bases that satisfied the preliminary review criteria were examined in depth as potential sources for the EIA's diesel fuel price series. This examination revealed that all sources were deficient in one or more areas of the review criteria (see Table 7.2), except the Department of Agriculture's Agricultural Prices.

The USDA's Crop Reporting Board publishes Agricultural Prices each month, with an annual summary edition. The diesel price data are collected from survey form OMB #40-R 1906, "Prices Paid by Farmers for Petroleum Products, Motor Supplies and Services." From 1970 to 1977, the price data were collected on the 15th of March, June, September and December. Since 1977, the data have been collected on the 15th of every month. Before 1980 the form was sent to 3000 diesel fuel dealers who were randomly selected by the USDA's state offices. A probability sample has been used since 1980 in which certain dealers respond every month and others are chosen at random. A follow-up telephone check is made of anomalous responses.

TABLE 7.2. Comparison of Diesel Fuel Price Data Bases

<u>Characteristics</u>	<u>USDA</u>	<u>APTA</u>	<u>BLS</u>	<u>PLATT'S</u>	<u>EIA-9A</u>
Definition of Diesel includes:					
No. 1-D	+	+	+	+	-
No. 2-D	+	-	+	+	+
Sectoral Coverage					
Industrial	+	-	-	-	-
Transportation	-	+	-	-	-
Level of Aggregation					
Company	-	-	-	-	+
City	-	-	-	+	-
State	+	-	-	-	-
DOE Region	-	+	-	-	-
Census Region	-	-	+	-	-
Type of Price					
Retail	+	+	-	-	+
Wholesale	-	-	+	+	-
Timely Availability of Data	+	+	+	+	+
Volume Weighted Price Available	-	+	-	-	+
Minimal Missing Data	+	+	+	+	-

+: Yes or available
-: No or unavailable

Prices are reported on a dollar per gallon basis, and represent the retail price paid by farmers for any combination of No. 1-D and No. 2-D diesel fuels on the 15th of each month. No annual price is available, and no volumes accompany the data to allow conversion of the monthly prices to volume-weighted annual prices. The data has been published since 1950 and there is a two week lag for publication of the monthly survey results. The data are available at the state level; however, regional price averages have been used to impute state values in the Northeast, and the combined average price of diesel in Delaware and Maryland has been assigned to each state.

The American Public Transit Association (APTA) publishes the Quarterly No. 1-D Diesel Fuel Price Report. Data for the report are collected from mailed

questionnaires sent to approximately 128 transit systems throughout the United States. Quarterly prices are reported on a dollar per gallon basis for each DOE region. No annual summary is available, but quarterly volumes are available for use in calculating an annual volume-weighted price. No imputation is performed for missing data and no attempt is made to validate responses. DOE Region 8 data are not available for most years. The report has been published since 1977, and has a five week delay to publication each quarter.

Wholesale diesel prices are available from the Bureau of Labor Statistics' Producer Prices and Price Indexes. The price data are collected from mailed questionnaires which are sent to 28 of the nation's largest refineries. The diesel prices are published monthly on a dollar per gallon basis for each Census Region. The data base has been available since 1975 with a sample size increase occurring in 1978. There is a one month publication lag with price revisions usually occurring four months after that. This data base is of limited value because the Census Region level of aggregation is very large, there are only five years of data available, and most importantly, the data base contains no information on end-use sectors.

Another source for diesel prices is Platt's Oil Price Handbook and Oilmanac. Wholesale diesel price data are available for selected refineries and terminals throughout the United States, but are aggregated with data for No. 2 fuel oil in many cases. The data are collected by telephone from the refineries and terminals at varying times throughout the year. Platt's has been published for fifty-three years with the sample size increasing over time. For the purpose of generating a diesel price series, Platt's has several drawbacks. The prices are not volume weighted and are not collected on a consistent basis, and the sample selection criteria are not disclosed. In addition, there is no specification of end-use sectors.

Diesel data for residential, commercial/industrial and institutional/utility sectors are gathered by the Energy Information Association on form EIA-9A, "No. 2 Distillate Price Monitoring Report." The forms are sent to retailers of No. 2-D diesel fuel and No. 2 fuel oil. Companies included in the sample were chosen from respondents to EIA-402, "Fuel Oil Distribution Survey," which is

sent to all firms retailing or reselling distillate, kerosene, and residual fuels. A random sample of 3000 company-state units, representing approximately 1800 individual companies, is required to submit data each month. The response rate averages 75 percent. Although nonresponses have resulted in some biases in the data, no imputation methodologies have been employed to adjust for missing data. The EIA has indicated, however, that imputation methods will be developed if nonresponse rates do not decline. Collected data are validated through selective audits. Although diesel prices are collected separately from No. 2 fuel oil prices on EIA-9A, prices are published for the weighted average of all No. 2 distillate. Data from EIA-9A have been available only since November, 1980. EIA-9A was preceded by EIA-9, which did not collect diesel price data.

7.2 OPTIONS FOR IMPUTING STATE-LEVEL PRICES

The transportation sector consumes almost all of the No.1-D diesel fuel, and most of the No.2-D diesel fuel available. Most diesel fuel is sold at filling stations and truck stops and few quantity discounts are available from these purchase sources. However, some firms in the transportation sector purchase diesel fuel through bulk deliveries. The price paid for bulk delivery of diesel fuel is higher than the wholesale price, but lower than the retail price at filling stations and truck stops.

All of the data sources used in generating diesel fuel prices also contain national as well as state-level data. To generate a national price series, the same procedures as described below for developing state-level prices can be followed using national instead of state-level data.

Information on the volume of bulk delivery diesel sales used in computing the price reported in Agricultural Prices is not available. To convert the monthly and quarterly prices in Agricultural Prices to volume-weighted annual prices, monthly volume weights from the U.S. Department of Transportation's Highway Statistics, publication will be used. These monthly weights, by state, measure the consumption (in thousands of gallons) of "special fuels" for transportation use. Special fuels consist primarily of diesel fuel, with a small amount of liquefied petroleum gas.

Step 1. Compute quarterly volume weights for 1970 through 1977.

$$HSXX_{t,q} = \sum_{m=1}^3 HSXX_{t,q,m} \quad (7.1)$$

Where:

$HSXX_{t,q}$ = volume weight for state XX in year t, in quarter q

$HSXX_{t,q,m}$ = volume weight for state XX in year t, in month m of quarter q

Step 2. Compute the annual volume-weighted transportation sector price (PXX_t).

1970-1977:

$$PXX_t = \sum_{m=1}^{12} \frac{(APXX_{t,m} \cdot HSXX_{t,m})}{\sum_{m=1}^{12} HSXX_{t,m}} \quad (7.2)$$

1978-1980:

$$PXX_t = \sum_{q=1}^{12} \frac{(APXX_{t,q} \cdot HSXX_{t,q})}{\sum_{q=1}^{12} HSXX_{t,q}} \quad (7.3)$$

Where:

$APXX_{t,q}$ = price observations for state XX in year t in quarter q from Agricultural Prices

$APXX_{t,m}$ = price observations for state XX in year t in month m from Agricultural Prices

7.3 RECOMMENDATIONS

There is no broadly based state-level retail price series published for diesel fuel. Both the Bureau of Labor Statistics and Platt's provide only wholesale, terminal or refinery prices. Starting in 1980, the EIA-9A inclusion of diesel fuel among the prices surveyed offers information drawn from a fairly broad sales base, but the diesel prices are not being published separately.

The American Public Transit Association data are developed from a narrow sales base and only a few years of data are currently available. As a result the best retail price data available are from Agricultural Prices. It is recommended that the state-level diesel price series be based on this data source.

7.4 SUMMARY OF AGENCY COMMENTS

Formal EIA review on the draft working paper raised the following two points that deserve comment:

1. The diesel fuel prices from Agricultural Prices may be biased in the sense that prices paid by farmers may differ from the prices paid by truckers or other diesel fuel users. It was suggested that Agricultural Prices data be compared with other selected diesel price series for general transportation.

Response: A comparison of the U. S. average wholesale prices for No. 2-D diesel published in the Monthly Energy Review and the U.S. average prices for No. 1-D prices paid by the public transit systems with the U. S. average diesel prices from Agricultural Prices is shown in Table 7.3. It can be seen that, after correcting for taxes, the three series are generally consistent with one another for the period from 1977 through 1980. The biases in the Agricultural Prices data, if any, are relatively small. More detailed analysis in this aspect is beyond the scope allowed by the resources of this project.

2. It was pointed out that the sensitivity of using the monthly volume data from Highway Statistics as weight in the computation of annual average prices be tested because the observed large annual fluctuations, and possible monthly fluctuations in some states in the Highway Statistics data.

Response: Since only the estimated actual monthly weights for each year, rather than the average weights derived from a period time, are being used, it is immaterial how large the fluctuations from year to year are if the weights in use accurately reflect the true consumption patterns for the states in each year. Note also that detailed sensitivity tests are outside the scope of this project.

8. KEROSENE AND JET FUELS

Kerosene is one of the lightest petroleum middle distillates, having burning properties suitable for use as an illuminant when burned in wick lamps. It includes range oil, which has properties similar to No. 1 fuel oil. Jet fuel includes JP4, which is naphtha-based, and JP5, which is a high-quality kerosene product. JP5 is used primarily by commercial airlines and the military. JP4 is much heavier than JP5 and is used almost exclusively by the military. It amounts to only a small share of total jet fuel consumption.

Almost all of the jet fuel consumed is used by the airline industry for transportation purposes. Electric utilities use both jet fuel and kerosene for fuel at steam-electric plants and as fuel in combustion turbine and internal combustion units. The residential sector uses kerosene primarily in space heaters, cooking stoves, and water heaters. The industrial sector uses kerosene as heating fuel or chemical solvent. There is little use of kerosene in the commercial sector.

In 1979, jet fuel and kerosene contributed 3.3 percent, or 2.59 Quads, to the total U.S. energy use of 79 Quads. Transportation sector use accounted for 85 percent of the combined product group, while the residential/commercial sectors accounted for another 10 percent. The remaining 5 percent was attributable to the industrial and electric utility sectors.

Since the chemical similarity between kerosene and kerosene-based jet fuel makes them interchangeable in some uses, most price data sources do not distinguish between the two fuel types. For this reason, prices reported for these two fuels are combined for the electric utility sector.

8.1 DATA BASE REVIEW

A working list of published sources of kerosene and jet fuel prices was compiled from: The American Gas Association's (AGA) Energy Statistics: North American and World Sources, 1977; the Ideamatics, Inc. report, Federal Energy Data System Analysis and Evaluation, 1978; the Energy Information Administration's EIA Publications Directory, 1980; and a search of bibliographies of energy-related publications. A preliminary examination of the identified

sources of kerosene and jet fuel price data revealed that no source met all of the established review criteria. A total of five price series met enough of the review criteria to be of use in imputing the kerosene and jet fuel price series. These sources are listed in Table 8.1. Most other sources were rejected because they were secondary sources of price data, or did not break out kerosene and jet fuel from the broader category of distillate fuels. These included the Annual Survey of Manufactures, EEI Statistical Year Book, Fuel Cost and Consumption, Journal of Commerce, Monthly Energy Review, Oil and Gas Journal, Oil Buyers Guide, and Oil Daily. Most of these sources were also rejected because they published only national prices. Aviation Fuels Retail Selling Prices was rejected because aviation gasoline was combined with jet fuel in all price data. The five sources shown in Table 8.1 were further evaluated to determine how each could be used to derive the required end-use price series. Characteristics of these sources are compared in Table 8.2.

TABLE 8.1 Candidate Sources of Kerosene and Jet Fuel Price Data

<u>Organization</u>	<u>Source</u>	<u>Form</u>
Energy Information Administration	<u>Cost and Quality of Fuels for Electric Utility Plants</u>	FPC 423
McGraw-Hill, Inc.	<u>Platt's Oil Price Handbook and Oilmanac</u>	--
Bureau of Labor Statistics	<u>Producer Prices and Price Indexes</u>	--
Energy Information Administration	<u>Monthly Petroleum Product Price Report</u>	EIA-460
U.S. Department of Agriculture, Crop Reporting Board	<u>Agricultural Prices</u>	OMB #40-R 1906

TABLE 8.2 Comparison of Kerosene and Jet Fuel Price Data Bases

<u>Characteristics</u>	<u>C&Q</u>	<u>Platt's</u>	<u>BLS</u>	<u>EIA-460</u>	<u>USDA</u>
Fuel Type Coverage					
Kerosene	+	+	+	+	+
Jet Fuel	+	-	+	+	-
Kerosene & Jet Fuel	+	-	-	-	-
Sectoral Coverage					
Industrial	-	-	-	-	(a)
Residential	-	-	-	-	(a)
Electric Utility	+	-	-	-	-
Transportation	-	-	-	-	-
Level of Aggregation					
City	-	+	-	-	-
State	+	-	-	-	+
Census Region	+	-	+	-	-
Nation	+	-	-	+	-
Type of Price					
Retail	+	-	-	+	+
Wholesale	-	+	+	+	-
Timely Availability of Data	+	+	+	+	+
Volume-Weighted Price Available	+	-	-	-	-
Years of Missing Data Since 1970	3 ^(b)	3 ^(c)	6	6	3

+: Yes or available
-: No or unavailable

- (a) Combined
(b) The data series starts in July 1972.
(c) The number of refineries and terminals reporting has varied considerably from year to year since 1973.

The most comprehensive price series identified is published in the EIA's Cost and Quality of Fuels for Electric Utility Plants. This source contains state-level prices since July 1973 for kerosene and jet fuel used in the electric utility sector. The price series data are collected by a questionnaire mailed to 300 electric utilities that operate 900 plants meeting the reporting criteria. Response to the questionnaire is mandatory and there is usually a 100 percent response rate. These data were subjected to computer edits and problems resolved through contacts with the utilities. Besides lacking data for 1970 through 1973, the time series has minor drawbacks in two other areas: 1) The questionnaire has been changed twice since 1973, and 2) missing data values are imputed by taking weighted averages based on the previous year's data.

The next most comprehensive price series was published in Agricultural Prices by the U.S. Department of Agriculture's Crop Reporting Board. Kerosene price data are available for 1970 to 1976. The survey was discontinued in January 1977. Survey form OMB #40-R 1906 was sent out at the middle of March, June, September, and December. The kerosene prices are reported on a dollar per gallon basis and represent the prices paid by farmers for kerosene as of the 15th day of each specified month. No annual prices are available, and no volumes accompany the data to facilitate conversion of the four quarterly prices to volume-weighted annual prices. The data are available at the state level, but have the disadvantage of combining industrial and residential sector uses of kerosene.

Platt's Oil Price Handbook and Oilmanac contains wholesale prices for kerosene in selected cities throughout the United States. The average annual prices reported are straight averages, not volume-weighted averages. Platt's collects the data by telephone survey of refineries and terminals throughout the nation. Following this, a telephone check is made of anomalous data. From 1970 to 1979, the number of cities reporting kerosene prices increased from zero to nineteen. Besides the problem of the small number of observations, the data base provides no information about end-use sectors. These two problems severely restrict the usefulness of this data base.

Monthly wholesale prices for jet fuel and kerosene are published in the Bureau of Labor Statistics' Producer Prices and Price Indexes. The data has

been available since July 1975, and is reported for the nine Census Regions. The data are collected from a questionnaire mailed each month to 28 of the nation's largest refineries. Response to the questionnaire is voluntary. Any price changes greater than ten percent from one month to the next are verified and any revisions usually appear four months after initial publication. Like Platt's, the data base does not provide any information on sectoral coverage, and this, in addition to its regional aggregation level, limits its usefulness.

National wholesale and retail prices for kerosene and jet fuel are published by the EIA in the Monthly Petroleum Product Price Report. These volume-weighted prices are published on a cents per gallon basis and are available since 1975. The data are collected on EIA-460, the "Petroleum Industry Monthly Product Price Report" (formerly FEA P302-M-1), which is mailed to petroleum dealers throughout the nation. The sample is stratified by dealer type and size with the number of respondents increasing from 1100 in 1975, to 1600 in 1980. Selective audits are performed to verify data, and there is no imputation of missing data. The delay to publication is about 45 days. While this data source does not specify any sectoral coverage, it is valuable because it contains mark-up information which can be used to convert wholesale prices from other data sources to retail prices.

8.2 OPTIONS FOR IMPUTING STATE-LEVEL PRICES

The data source review in the previous section determined that there were no complete price series available for any sector containing data for every year since 1970. Therefore, some imputation is required for each sector. The only data source which contains any price data for 1970 to 1973 is Agricultural Prices, which contains kerosene price data for 1970 through 1976.

8.2.1 Transportation Sector

Jet fuel is sold almost exclusively to the transportation sector, which uses only small amounts of kerosene. Prices for jet fuel that are not identified by end use are, therefore, assigned as the transportation sector price. Since there are no state-level price data, prices are developed on a regional rather than state basis.

The primary data source for imputing the transportation sector price is Producer Prices and Price Indexes (PPI). This data source contains whole-sale price data for jet fuel by Census Region for the period since 1976. No attempt is made to convert the wholesale prices to retail because available mark-up information from the Monthly Petroleum Product Price Report does not permit a consistent conversion. The regional average wholesale prices are assigned to the states in each Census Region. To develop regional prices for 1970 to 1975, for which PPI data are not available, regression equations are developed to link PPI national average prices to regional jet fuels prices as well as to the national average kerosene price series of the Independent Petroleum Association of America (IPAA) reported by Platt's.

Since the PPI regional prices are monthly data, it is necessary to calculate average annual prices. For this purpose, it is most appropriate to use data on monthly consumption of jet fuel by state or by region as quantity weights. In the draft working paper, we proposed to use the data compiled by Ethyl Corporation. However, confidentiality considerations prevented the use of these data. Since the monthly fluctuations in jet fuel usage are small, use of a simple average probably does not lead to significant bias.

The following steps are involved in developing the jet fuel price series for the transportation sector.

1976-1980

Step 1. Compute Census Region annual wholesale prices of jet fuel from the PPI monthly data by simple averaging.

Step 2. Assign Census Region prices to each state within the region.

1970-1975

Step 1. Because U.S. wholesale jet fuel prices from the PPI are available only since 1973, the following linking equation is estimated using data for the period 1973-1980.

$$PJFUS_t = 3.1839 + 1.0404 PKSIPAA_t \quad (8.1)$$

$$(-1.554) \quad (21.862)$$

$$R^2 = 0.9876 \quad d.f. = 6 \quad D.W. = 3.120$$

Where:

$PKSIPAA_t$ = wholesale price of kerosene according to
Independent Petroleum Association of America

Step 2. Use Equation 8.1 and data from IPAA to impute U.S. average wholesale prices of jet fuel for 1970-72.

Step 3. Estimate the following regression equation for imputation using pooled cross-sectional time series data for the nine Census Regions from PPI during 1976-1980.

$$PJF_{j,t} = a + b \cdot PJFUS_t + \sum_{j=2}^9 c_j \cdot DJ \quad (8.2)$$

Where:

$PJF_{j,t}$ = wholesale price of jet fuel in region j in year t

$PJFUS_t$ = wholesale price of jet fuel from the U.S. in year t

DJ = Dummy variable for Census Region j. Census Region 1 was the reference region, so it was dropped from the equation.

The actual equation was run in the logarithmic form; results are as follows:

$$\begin{aligned} \log (PJF_{j,t}) = & 0.1079 + 1.0119 \log (PJFUS_t) - 0.0250 D2 \\ & (9.676) \quad (125.236) \quad (-1.983) \\ & + 0.0214 D3 - 0.0110 D4 - 0.1412 D5 \\ & (1.700) \quad (-0.878) \quad (-11.217) \\ & + 0.0285 D6 + 0.0423 D7 + 0.0197 D8 \\ & (2.263) \quad (3.359) \quad (1.568) \\ & - 0.0202 D9 \\ & (-1.594) \end{aligned} \quad (8.2a)$$

$$R^2 = 0.9978 \quad d.f. = 35 \quad D.W. = 1.798$$

Step 4. Use Equation 8.2a and available average wholesale prices of jet fuel for 1970-1975 to estimate regional wholesale prices of jet fuel for the same period.

Step 5. Assign regional prices to each state in the region.

8.2.2 Electric Utility Sector

Electric utility sector prices in Cost and Quality of Fuels for Electric Utility Plants are for kerosene and small amounts of jet fuel for use in steam electric plants, and in combustion turbine and internal combustion units. Prices and volumes are available for each use since 1973. Prices for 1970 through 1972 are estimated using a regression equation linking Cost and Quality data to Agricultural Prices data for 1973 through 1977.

- Step 1. For the time period since 1973, compute the end-use weighted electric utility sector price for states (PXX_t) and the U.S. (PUS_t) and enter them in the data base.

$$PXX_t = \frac{PCQXX_t \cdot VCQXX_t}{VCQXX_t} \quad (8.3)$$

Where:

PXX_t = volume weighted price for state XX or the U.S. in year t

$PCQXX_t$ = price for state XX or the U.S. in year t from Cost and Quality

$VCQXX_t$ = volume for state XX or the U.S. in year t from Cost and Quality

- Step 2. Develop a regression equation linking the utility sector price calculated in Equation 8.3 to the average annual state and national prices for kerosene from Agricultural Prices for 1973-1976

- i. Compute average annual state and national prices from Agricultural Prices data.

$$PAPXX_t = \frac{1}{4} \sum_{q=1}^4 PAPXX_{t,q} \quad (8.4)$$

Where:

$PAPXX_t$ = annual average kerosene price for state XX in year t

$PAPXX_{t,q}$ = quarterly kerosene price for state XX in year t, in quarter q from Agricultural Prices

- ii. Develop a regression equation linking prices ($PAPXX_t$) from Equation 8.4 to prices (PXX_t) calculated in Equation 8.3 for 1973 to 1977.

$$PXX_t = a + b PAPUS_t + \sum_{XX=1}^{51} c_{XX} (DXX \cdot PAPXX_t) \quad (8.5)$$

Where:

D_{XX} = dummy variable for state XX.

Using the available state data for 1974-1977, the regression results are as follows:

$$PXX_t = 0.1094 + 0.5236 PAPUS_t + \sum_{XX=1}^{51} c_{XX} (DXX \cdot PAPXX_t) \quad (8.5a)$$

(2.1939) (4.3469)

$$R^2 = .6782 \quad d.f. = 28 \quad D.W. = 2.753$$

The estimated values of c_{XX} and the associated t-values are shown in Table 8.3.

Step 3. Using Equation 8.5a, calculate state and U.S. prices for 1970 to 1972 based on the available Agricultural Prices data for the same period.

8.2.3 Residential Sector

Residential sector prices for kerosene are available in Agricultural Prices for 1970-1976. These quarterly price observations can be converted to annual prices using monthly volume weights for Petroleum Administration for Defense (PAD) Districts. These volume weights are published in Table 2 of the EIA publication, Retail Sales and Inventories of Fuel Oil, under the classification "other distillate fuel oil." This category includes No. 1 and No. 4 fuel oil, No. 1-D and No. 4-D diesel fuel, kerosene, and light gas enrichment oil. No sectoral coverage is specified, but the fuels in this

TABLE 8.3. Estimated values of c_{xx} for Equation 8.5a

<u>State</u>	<u>c_{xx}</u>	<u>t</u>
AZ	0.0349	1.2254
FL	0.0078	0.1958
OR	0.0321	0.9194
NY	-0.0063	-0.2216
CA	0.0006	0.0311
CT	-0.0508	-1.7438
IL	0.0354	1.2084
MD	-0.0178	-0.6200
MI	-0.0273	-0.9154
NH	-0.0376	-1.2889
NJ	-0.0287	-1.0978
OH	0.0093	0.2954
PA	0.0269	0.7844
VT	0.0230	0.7899
WA	0.0587	2.3278
WI	-0.0375	-1.1966
WV	0.0461	1.5904

category are similar in chemical composition to kerosene, and most are consumed by the residential sector as heating fuel. Since kerosene is used by the residential sector as a heating fuel, these volume weights will reflect the residential sector's cyclical consumption of kerosene. Using straight averages to generate annual prices would not account for this cycle. Since the volume data are available only from November 1978 to March 1981, data for these months will be used to generate average monthly volume weights for use in all years.

For the years in which residential sector kerosene price data are available from Agricultural Prices, 1970 to 1976, an annual weighted average of these quarterly prices will be calculated for each state. The average ratio of state-level Agricultural Prices data to PPI regional prices from the third quarter of 1975 through the fourth quarter of 1976 are used to derive state kerosene prices for 1977 and later years.

1970-1976

- Step 1. Calculate average monthly and quarterly volume weights for each PADD from the 1978 to 1981 monthly sales data described above, and assign them as weights for each of the states within the PAD district.

Monthly Data

$$WXX_{j,m} = \frac{1}{N} \sum_{t=78}^{81} W_{j,t,m} \quad (8.6)$$

Where:

$WXX_{j,m}$ = volume weight for state XX, in PADD j, in month m

$W_{j,t,m}$ = volume in PADD j in year t, in month m from Retail Sales and Inventories of Fuel Oil

N = number of years of non-zero data for month m

Quarterly Data

$$WXX_{j,q} = \frac{1}{3} \sum_{m=1}^3 W_{j,q,m} \quad (8.7)$$

Where:

$W_{j,q,m}$ = volume for PADD j, in month m of quarter q from Retail Sales and Inventories of Fuel Oil

Step 2. Compute the volume-weighted annual residential sector price for kerosene (PXX_t).

$$PXX_t = \frac{\sum_{q=1}^4 (PAPXX_{t,q} \cdot WXX_{j,q})}{\sum_{q=1}^4 WXX_{j,q}} \quad (8.8)$$

Where:

$PAPXX_{t,q}$ = price observations for state XX in year t, in quarter q from Agricultural Prices

After 1976

Step 3. The ratios of the PPI data to the Agricultural Prices from the third quarter of 1975 through the fourth quarter of 1976 are calculated and applied to the PPI data during the period 1977-1980 to derive the desirable state-level kerosene prices.

- i. Calculate PPI quarterly prices for 1975 to 1977 and assign them to the states in each census region ($PPPIXX_{j,t,q}$).

$$PPPIXX_{j,t,q} = \frac{1}{3} \sum_{m=1}^3 PPPIXX_{j,t,q,m} \quad (8.9)$$

Where:

$PPPIXX_{j,t,q,m}$ = price from the PPI for state XX in region j, in year t, in quarter q in month m

- ii. Compute the average ratio (RXX) of Agricultural Prices data to PPI data for state XX from the third quarter of 1975 through the fourth quarter of 1976.

$$RXX = \frac{1}{6} \sum_{q=1}^6 (PAPXX_{j,t,q} \div PPPIXX_{j,t,q}) \quad (8.10)$$

- Step 4. Calculate the volume-weighted annual price ($PPPIXX_t$) from PPI data since 1976.

$$PPPIXX_t = \frac{\sum_{m=1}^{12} (PPPIXX_{j,t,m} \cdot WXX_{j,t,m})}{\sum_{m=1}^{12} WXX_{j,m}} \quad (8.11)$$

- Step 5. For the years since 1976 calculate residential sector prices (PXX_t) according to the following equation:

$$PXX_t = RXX \cdot PPPIXX_t \quad (8.12)$$

- Step 6. To calculate U.S. price (PUS_t), compute the weighted average of the state prices developed in Steps 2 and 5, using volume weights from State Energy Data System.

$$PUS_t = \frac{\sum_{XX=1}^{51} (PXX_t \cdot SVXX_t)}{\sum_{XX=1}^{51} SVXX_t} \quad (8.13)$$

8.2.4 Industrial Sector

None of the available data sources provide industrial sector prices of kerosene. It is possible, however, by making the following assumption, to approximate the retail kerosene prices for the industrial sector.

Assumption: It is assumed that the ratios of industrial sector retail prices to wholesale prices of kerosene in each state are the same as those for distillate fuels used in the industrial sector.

It follows from the above assumption:

$$\frac{PKSXX_t}{WKSXX_t} = \frac{PDFXX_t}{WDFXX_t} \quad (8.14)$$

Where:

$PKSXX_t$ = retail prices for kerosene in state XX, in year t

$WKSXX_t$ = wholesale prices for kerosene in state XX, in year t

$PDFXX_t$ = retail prices for distillate fuel in state XX, in year t

$WDFXX_t$ = wholesale prices for distillate fuel in state XX, in year t

Since wholesale prices for kerosene and distillate fuels are available from the PPI for the period 1975-1980, the industrial sector kerosene prices can be calculated directly from the industrial distillate prices according to the following equation:

$$PKSXX_t = PDFXX_t (WKSXX_t \div WDFXX_t) \quad (8.15)$$

Since wholesale prices for kerosene and distillate fuels are not available for 1974 and earlier, the average wholesale price ratio for the 1975-1980 period are used for estimating prices for the 1970-1974 period:

as those facing the agricultural sector. Note also that, due to practical considerations in implementation, there are changes in the procedure documented here from those explained in the draft working paper.

2. Since there were no reported industrial sector price data, it was suggested that no industrial sector price series be developed, or that the resulting series be labeled as "agricultural sector", rather than "industrial sector".

Response: Due to changes in the imputation procedure, this point is moot.

$$PKSXX_t = PDFXX_t \frac{1}{6} \sum_{t=75}^{80} (WKSXX_t \div WDFXX_t) \quad (8.16)$$

8.3 RECOMMENDATIONS

It is recommended that jet fuel prices alone be used for the transportation sector and that these be developed at the Census Region level and for wholesale transactions. The jet fuel prices should be based on PPI regional data for 1976 and thereafter. The 1970-1975 prices can be imputed from PPI national averages and IPAA data. Electric utility sector prices can be taken from Cost and Quality of Fuels after 1973. Prior to 1973, the prices can be imputed using Agricultural Prices data. From 1970 to 1976, kerosene prices for the residential sector can be taken from Agricultural Prices. After 1976 these prices can be imputed using the PPI data. Since no kerosene price series is available for the industrial sector, it is recommended that price estimates be developed by assuming that the ratios of industrial sector retail kerosene prices to wholesale prices are the same as those for distillate fuels.

8.4 SUMMARY OF AGENCY COMMENTS

In addition to providing additional information and minor corrections, the formal EIA review of the draft working paper on kerosene and jet fuel price series raised two issues.

1. It was pointed out that all price estimates for kerosene and jet fuel were dependent to some degree upon the Agricultural Prices data. Therefore, the question of whether the prices paid by farmers for their fuels were the same as those paid by the commercial airline industry and the military should be addressed.

Response: Except for their use in the residential sector, the use of the Agricultural Prices data assume only that the prices for each sector under consideration followed the same general trend as the kerosene prices reported in the Agricultural Prices. While the realism of this assumption needs to be tested, it is less restrictive than the assumption that prices facing the other sectors were at the same levels

9. RESIDUAL FUEL

Residual fuel refers to the class of heavy fuel oils that remain after the distillate fuel oils and lighter hydrocarbons are boiled off in the petroleum refining process. Residual fuels include No. 5 and No. 6 fuel oils, heavy diesel oil, Navy special fuel, Bunker C fuel oil, and acid sludge and pitch when they are used as fuels. No. 4 fuel oil is sometimes treated as a residual fuel; however, it is included in the distillate price series because it is more accurately defined as a middle distillate. The residual price series developed in this report focuses on the prices for No. 5 and No. 6 fuel oil, though prices for other fuels are included when available. It should be noted that the prices of residual fuels, especially No. 5 and No. 6 fuel oils, vary by sulfur content. The sulfur content of fuel oil does not determine the heat value of the fuel, but it affects the pollutant level when burned. Higher sulfur levels in residual fuel are usually reflected in lower prices.

Residual fuel is used in the commercial, industrial, transportation, and electric utility sectors. Commercial sector uses of residual fuel include space and water heating. The manufacturing, mining, and construction industries, which comprise the industrial sector, commonly use residual oils for fuel. Within the transportation sector, residual fuels are used most commonly in waterborne shipping and railroads. The utility sector, which includes both publicly and privately owned electric utilities, uses residual fuels to generate electricity.

In 1979, residual fuels supplied an estimated 8 percent, or 6.5 quads of the total U.S. energy consumption of 79 quads. The electric utility sector accounted for nearly half (48 percent) of the total residual fuel use in the U.S. The industrial, transportation, and commercial sectors accounted for 28, 15, and 9 percent, respectively.

9.1 DATA BASE REVIEW

A working list of published sources of residual fuel prices was compiled from: the American Gas Association's (AGA) Energy Statistics: North American and World Sources, 1977; the Ideamatics, Inc. report, Federal Energy Data System Analysis and Evaluation, 1978; the Energy Information Administration's

EIA Publications Directory, 1980; and a search of bibliographies of energy-related publications. Preliminary examination of the identified sources of published residual fuel price data narrowed the field of candidate data bases to six that met or nearly met the established review criteria. These six data bases are listed in Table 9.1 by source organization. Among sources reviewed and determined unsuitable for the purpose of developing state-level residual fuel price series were Oil and Gas Journal, Energy User News, Journal of Commerce, Oil Buyer's Guide, and Oil Daily; these publications either do not publish retail prices, print prices from other sources, or publish prices for very limited geographic areas.

A summary of key characteristics of the six candidate data bases identified is presented in Table 9.2. The most comprehensive data bases for a given end-use sector were the Energy Information Administration's Cost and Quality of Fuels for Electric Utility Plants and the Edison Electric Institute's Statistical Year Book of the Electric Utility Industry, both of which cover the electric utility sector. The industrial sector is the only other end-use sector specifically covered by a data base with state-level prices: Annual Survey of Manufactures and the Census of Manufactures.

TABLE 9.1. Candidate Sources of Residual Fuel Price Data

<u>Organization</u>	<u>Source</u>	<u>Form</u>
Energy Information Administration	<u>Cost and Quality of Fuels for Electric Utility Plants</u>	FPC 423
Bureau of the Census	<u>Annual Survey of Manufactures</u>	MA-100
Edison Electric Institute	<u>Statistical Year Book of the Electric Utility Industry</u>	--
McGraw-Hill, Inc.	<u>Platt's Oil Price Handbook and Oilmanac</u>	--
Bureau of Labor Statistics	<u>Producer Prices and Price Indexes</u>	--
Energy Information Administration	<u>Petroleum Industry Monthly Report for Product-Prices</u>	EIA-460 FEA-P302-M-1

TABLE 9.2. Comparison of Candidate Residual Fuel Price Data Bases

Characteristics	FPC 423	ASM	EEI	Platt's	PPI	EIA-460
Definition of Residual includes:						
No. 5 fuel oil	+	+	+(a)	+	-	+
No. 6 fuel oil	+	+	+(a)	+	+	+
by sulfur content	+	-	-	+	+	+
Marine diesel	-	+	-	+	-	-
Bunker C	-	+(b)	-	+(c)	-	+
Other	-	+	-	+	-	-
Sectoral coverage:						
Commercial	-	-	-	-	-	-
Industrial	-	+	-	-	-	-
Transportation	-	-	-	-	-	-
Utility	+	-	+	-	-	-
State-level estimates	+	+	+	-	-	-
Timely availability of data	+	-	+	+	+	+
Minimal missing data	+	+	+	-	-	-
End-user prices	+	+	+	-	-	+(d)

+: Yes or available.

-: No or unavailable.

(a) Also includes distillates, crude oil, and small amounts of tar and gasoline.

(b) Heavy gas enrichment oil.

(c) Marine gasoil.

(d) Wholesale and retail prices.

The quality of the Cost and Quality of Fuels residual fuel oil price data is judged to be adequate for the residual fuel price series. Average delivered prices in cents per million Btu and in dollars per barrel are available for No. 5 and No. 6 fuel oils at six levels of sulfur content. These aggregates are generated from a monthly survey on FPC Form 423. These data are collected as quantity of fuel received, quality of fuel received (by average Btu, sulfur content to the nearest .01 percent, and costs in cents per million Btu to the nearest .1 cent). Submission of FPC-423 is required of all electric utility plants with a generating capacity of at least 25 megawatts, for any month in which fossil fuels are delivered. These data are collected from 300 utilities

reporting for 900 plants. Collected data are validated through computer edits and an EIA follow-up procedure. The only changes in collection methods were minor form alterations in 1974 and 1977. The lag to publication for the annual edition is usually about five months, and the residual oil prices, which are aggregated to the state level, are available from July 1973 to the present.

The EEI Statistical Year Book contains average delivered prices per million Btu and per barrel for "oil", defined to include both distillate and residual fuel oils, crude oil, and small amounts of tar and gasoline. About 20 years of state-level prices are available. The EEI survey covers approximately 97 percent of the electric utility industry. Submission of annual or monthly statistical reports is voluntary. Missing data are not imputed and there have been no changes in data collection procedures. Data are verified by cross checks of monthly and annual data. The annual publication is generally available with a time lag of 10 to 13 months.

Industrial sector residual oil price data are compiled by the U.S. Department of Commerce, Bureau of the Census using Form MA-100 and are published in the Census of Manufactures (CM) and the Annual Survey of Manufactures (ASM). The ASM contains delivered cost and quantity data from which prices can be generated. While CM data are available at the state level and have been published periodically since 1950, data that permit calculation of volume weighted prices are only available for 1971 and years after 1974. Completion of Form MA-100 is required of 70,000 manufacturing companies which represent all firms with more than 250 employees and some smaller firms, added to constitute a probability sample. MA-100 is collected annually and the data are verified by computer and analytical checks for consistency with historic trends and current industry patterns. No imputations are done for missing data and there have been no changes in data collection procedures. Although the quality of the ASM/CM data is reasonable for use in the residual fuel price series, the Bureau of the Census has not been able to keep the lag to publication under one year. At present, data are available only for 1971 and 1974 through 1979. In addition, because the data only covers the manufacturing industries, it does not offer complete coverage of the industrial sector.

The Energy Information Administration collects fuel oil prices and volumes on Form EIA-460, "Petroleum Industry Monthly Report for Product Prices."

EIA-460 is sent to all refiners, resellers, and retailers who derive \$50 million or more annually from the sale of covered products. Participation in the survey is mandatory and the monthly sample size is about 1120 firms. Data collection with EIA-460 began in September 1980; from July 1975 to August 1980 comparable data was collected with form FEA-P302-M-1.

Residual fuel prices collected with EIA-460 are monthly volume-weighted averages in dollars per barrel. Both wholesale and retail prices are collected for the following fuels: No. 5 fuel oil, No. 6 fuel oil by sulfur content, and Bunker C fuel. Collected data are verified by selective audits and checks for consistency with past trends. Firms are contacted if data are not submitted, and if data are not available the marking "N/A" is used. There have been no changes in collection methods, and the lag to publication is about four months.

Two characteristics make the EIA-460 data unsuitable for direct use in the residual fuel price series. First, because EIA-460 is filled out by sellers instead of purchasers, there is no way to identify end-use buyers by sector. Retail prices of Bunker C fuel could possibly be assigned to the transportation sector however, since this fuel is used primarily in waterborne shipping. Second, although the data are collected at the company level, the residual fuel data are only published at the national level, in the Monthly Petroleum Product Price Report and Monthly Energy Review.

The last two candidate data bases for residual fuel oil prices are Platt's Oil Price Handbook and Oilmanac and Producer Prices and Price Indexes. Both report only wholesale prices. Neither of these sources contains end-use prices, end-use sector definitions, or state-level prices and is therefore unsuitable for direct use in the residual fuel price series.

Platt's Oil Price Handbook and Oilmanac, a McGraw-Hill, Inc. publication, contains monthly and annual averages of refinery and terminal prices by city. Residual oil products covered by Platt's are No. 5 and No. 6 fuel oils, marine diesel, marine gasoil, and Bunker C fuel. Like EIA-460, prices for marine diesel, gasoil, and Bunker C fuel oil could be allocated to the transportation sector although Platt's does not specify end-use sectors. Prices are collected daily by telephone surveys and verification consists of checks of anomalous data. Participation in the Platt's survey is voluntary, and the sample size

varies depending upon the number of refineries, terminals, or pipelines in each city area. The total number of terminals reporting has increased over time but there have been no other changes in collection methods. Missing data points are not imputed. Over 50 years of price data have been collected by Platt's and the lag to publication is less than ten months.

Producer Prices and Price Indexes is a Bureau of Labor Statistics (BLS) publication that contains residual fuel prices by Census Regions. Average realized wholesale prices in dollars per gallon are available for No. 6 fuel oil by three levels of sulfur content. Prices are lagged one month and no end-use sectors are specified. Every month, BLS questionnaires are submitted voluntarily by a size stratified sample of 28 refineries. Revisions occur four months after the original publication, which usually has a publication lag of one month. Missing data are not imputed but are marked unavailable. Consistent data are available from 1975 to the present.

9.2 IMPUTATION PROCEDURES

While state-level data for both the electric utility and industrial sectors covering a major portion of the period under consideration are available, imputation is required to extend the annual data back to 1970. The commercial and transportation sector price series are imputed from the national average prices from EIA-460 and the state-level prices for the industrial sector.

9.2.1 Electric Utility Sector

For 1973 to the present the Cost and Quality of Fuels data are clearly the best available. Since these data are unavailable for 1970 through 1972, the EEI Statistical Year Book data are used to impute those years. The EEI data cannot be used directly because the reported prices cover a broad range of refined petroleum products, not just residual fuel. The following steps are needed to impute the prices for the earlier period:

Step 1. Estimate the relationships between the EEI state data and Cost and Quality state data for 1973 through 1980.

$$PCQXX_t = a + b \cdot PEEIXX_t + \sum_{XX=1}^{51} c_{XX} \cdot DSXX \quad (9.1)$$

Where:

$PCQXX_t$ = price observations from Cost and Quality for state XX in year t

$PEEIXX_t$ = price observations from the EEI data for state XX in year t

$DSXX$ = dummy variable for state XX

In estimation, various equation forms were tried. The logarithmic form was eventually adopted. Using pooled state-level data from 1973-1980, the following equation was derived for physical unit prices:

$$\log PCQXX_t = 0.0589 + 0.9812 \log PEEIXX_t + \sum_{XX=1}^{51} c_{XX} \cdot DSXX \quad (9.1a)$$

(0.988) (59.586)

$$R^2 = 0.9368 \quad d.f. = 258 \quad D.W. = 1.671$$

Estimates of coefficient c_{XX} and the associated t values are shown in Table 9.3 for physical unit prices. Because the proportions of No. 5 and No. 6 fuel oils used by electric utilities in different states varied over the years, the conversion factor from physical units to Btu varied by states and by years. Since, Cost and Quality of Fuels also provided Btu prices, a separate regression was estimated for Btu prices:

$$\log PCQXX_t = 0.0215 + 0.9849 \log PEEIXX_t + \sum_{XX=1}^{51} c_{XX} \cdot DSXX \quad (9.1b)$$

(0.476) (58.650)

$$R^2 = 0.9352 \quad d.f. = 258 \quad D.W. = 1.744$$

Estimates of coefficient c_{XX} and the t-values are shown in Table 9.4. Note that, in both Equations (9.1a) and (9.1b), Massachusetts (XX = 20) was used as the reference state and, hence, there was no dummy variable for Massachusetts. Moreover, some states were not include in the regression equation because there were no actual observation for them in the Cost and Quality of

TABLE 9.3. Estimated Values of c_{XX} in Equation 9.1a

State	c_{XX}	t	State	c_{XX}	t
AR	-0.0591	-0.9450	MT	0.0266	0.3085
AZ	0.0181	0.2885	NC	-0.1081	-1.3942
CA	-0.0103	-0.1641	NE	-0.0474	-0.7571
CO	-0.1734	-2.7699	NH	-0.0053	-0.0851
CT	0.0088	0.1411	NJ	0.0022	0.0359
DC	0.0401	0.6402	NM	-0.0752	-1.2011
DE	0.0357	0.5707	NV	0.0558	0.8916
FL	0.0105	0.1677	NY	-0.0017	-0.0265
GA	-0.1355	-2.1653	OH	-0.0743	-1.1859
HI	-0.0481	-0.7683	OK	-0.0379	-0.5575
IA	-0.2594	-1.9045	PA	-0.0233	-0.3726
IL	-0.0858	-1.3701	RI	0.0143	0.2292
KS	0.0480	0.7657	SC	-0.0070	-0.1110
LA	-0.0995	-1.5898	SD	-0.0351	-0.5606
MD	-0.0253	-0.4040	TX	0.0118	0.1878
ME	0.0392	0.6259	UT	-0.0062	-0.0993
MI	0.0564	0.9008	VA	-0.0087	-0.1395
MN	0.0309	0.4943	WA	-0.3494	-4.5141
MO	-0.0678	-1.0835	WI	-0.1272	-2.0316
MS	-0.0389	-0.6212			

TABLE 9.4. Estimated Values of c_{XX} in Equation 9.1b

State	c_{XX}	t	State	c_{XX}	t
AR	-0.0611	-0.9622	MT	-0.0574	-0.6573
AZ	-0.0038	-0.0593	NC	-0.1361	-1.7306
CA	-0.0160	-0.2525	NE	-0.0761	-1.1985
CO	-0.2032	-3.1984	NH	-0.0079	-0.1247
CT	0.0080	0.1261	NJ	-0.0055	-0.0867
DC	0.0357	0.5626	NM	-0.0921	-1.4506
DE	0.0287	0.4525	NV	0.0504	0.7941
FL	0.0091	0.1427	NY	-0.0049	-0.0767
GA	-0.1637	-2.5784	OH	-0.1403	-2.2069
HI	-0.0490	-0.7713	OK	-0.0906	-1.3132
IA	-0.2933	-2.1236	PA	-0.0347	-0.5468
IL	-0.1130	-1.7785	RI	0.0193	0.3034
KS	0.0246	0.3867	SC	-0.0143	-0.2253
LA	-0.1103	-1.7368	SD	-0.0112	-0.1761
MD	-0.0309	-0.4860	TX	0.0006	0.0096
ME	0.0391	0.6156	UT	-0.0287	-0.4521
MI	0.0229	0.3605	VA	-0.0136	-0.2145
MN	0.0097	0.1524	WA	-0.3750	-4.7766
MO	-0.1334	-2.1015	WI	-0.2052	-3.2314
MS	-0.0514	-0.8086			

Fuels data. These are: Alaska, Alabama, Idaho, Indiana, Kentucky, North Dakota, Oregon, Tennessee, Vermont, West Virginia, and Wyoming.

Step 2. Calculate the missing state prices from the parameter estimates of Equations 9.1a and 9.1b using the EEI data from 1970 through 1972 and enter the calculated prices in the data base.

9.2.2 Industrial Sector

Annual state-level data from the Annual Survey of Manufactures and Census of Manufactures (ASM/CM) are presently available for the industrial sector for the years 1971 and 1974 through 1979. Prices calculated from these sources can be used directly for these years. Price data for the years of 1970, 1972 and 1973 have to be imputed. Because of the lag to publication, imputed prices for 1980 are preliminary estimates, which will then be replaced by the actual data from ASM/CM when they become available. The following steps are involved in deriving a complete series of state-level industrial sector residual fuel prices from CM and ASM.

Step 1. Divide total consumption of residual fuels from CM and ASM data for 1971 and 1974-1979 for each state into the corresponding total cost to calculate the volume-weighted average price (PXX_t) and enter in the STEPS data base.

Step 2. Calculate the average apparent percentage margin for the 1974-1978 period for each state by comparing the prices derived in Step 1 above with Platt's terminal and refinery prices for No. 6 fuel oil assigned to each state. These average margins are then applied to the respective Platt's data for 1980 to estimate prices for this year.^(a)

Step 3. For 1970, 1972 and 1973, as well as the missing data points for 1971, the industrial price (PXX_t) is derived from the national average price developed for the electric utility sector ($PUTUS_t$). The following regression equation is estimated.

(a) This represents a change from the procedure proposed in the draft working paper, necessitated by the unsatisfactory performance of the estimated regression equation in projecting outside the data period. See Section 9.5 for the approach initially proposed.

$$\begin{aligned}
PXX_t = & a + b \cdot PUTUS_t + \sum_{XX=1}^{19} d_{XX} \cdot DSXX + \sum_{XX=21}^{51} d_{XX} \cdot DSXX \\
& + \sum_{XX=1}^{19} g_{XX} (DSXX \cdot PUTUS_t) + \sum_{XX=21}^{51} g_{XX} (DSXX \cdot PUTUS_t) \quad (9.2)
\end{aligned}$$

Where:

PXX_t = industrial sector price of residual fuel from ASM
and CM for 1971, and 1974 through 1978

The equation is in the general form allowing for state variations in the parameter estimates for a and b. In the actual regression runs, variations of the equation were examined. If the composite variable $PUTUS_t \cdot DSXX$ was dropped, the estimate of coefficient d_{XX} would reflect the variation in the intercept term a, due to state differences, while the estimate for the "slope" term, b, would be held constant for all states. If the dummy variable DSXX were dropped from the equation, changes in the estimate for b would be permitted through the coefficient estimate of g_{XX} while holding constant the intercept term, a. These options will be explored in fitting the equation to the data.

If data for all 50 states and the District of Columbia are available for 1971 and 1974-1978, then there will be 306 observations with 102 parameters to be estimated. The maximum degrees of freedom are, therefore, 204. Since values for many states will be missing, the actual degrees of freedom will be lower.

In estimating Equation 9.2, differences in both the intercept and the slope terms were allowed. The following coefficients were estimated from the pooled data for 1971 and 1974-1978:

$$PXX_t = 0.4588 + 1.0122 \text{ PUTUS}_t + \sum_{XX=1}^{51} d_{XX} \cdot DSXX + \sum_{XX=1}^{51} q_{XX} (DSXX \cdot \text{PUTUS}_t) \quad (9.2a)$$

(0.828) (17.605)

$$R^2 = 0.9663 \quad d.f. = 185 \quad D.W. = 2.593$$

The values of d_{XX} , q_{XX} , and the associated t-values are shown in Table 9.5. Note that in estimating (9.2a), Massachusetts (XX=20) was taken as the reference state. In addition, lack of any data points also make it necessary to drop Montana, New Mexico, Nevada, Oklahoma, and Wyoming from the regression.

Step 4. Calculate the industrial sector prices by using Equation 9.2a and the U.S. electric utility sector prices for 1970-1973 from EEI.

9.2.3 Commercial Sector

Data from EIA-460 yield national average retail prices (excluding tax) for No. 6 residual oils for the period since 1975. This price is the volume-weighted average price of all residual oils sold directly to all end users including electric utilities, industries, commercial establishments, railroads, ships, and others. No data is available for disaggregation of the commercial sector from this total. Therefore, in order to derive state-level prices for the commercial sector, it is assumed that the proportional relationship between each state-level residual oil price and the national average residual oil price for the commercial sector is the same as it is for the industrial sector.

Given this assumption, the following equation is used to estimate state-level residual prices for the commercial sector:^(a)

$$PCXX_t = PIXX_t (PF460US_t \div PIUS_t) \quad (9.3)$$

Where:

$PCXX_t$ = residual oil price for commercial sector for state XX in year t

$PIXX_t$ = residual oil price for the industrial sector for state XX or the U.S. derived in Section 9.2.2

(a) This is a change from the procedure included in the draft working paper, necessitated by the excess variations of estimated prices derived in using the procedure proposed earlier, which are shown below in Section 9.5.2.

TABLE 9.5. Estimated Values of d_{XX} and g_{XX} in Equation 9.2a

State	d_{XX}	t	g_{XX}	t
AK	0.1900	0.1578	-0.1527	-1.4007
AL	0.7505	0.6234	-0.1900	-1.7425
AR	0.3756	0.3120	-0.2772	-2.0840
AZ	-0.2365	-0.1965	-0.1007	-0.9234
CA	0.3203	0.2661	-0.2144	-1.9672
CO	-0.2093	-0.1739	-0.1692	-1.5526
CT	-0.4780	-0.3971	0.0821	0.7529
DC	0.5772	0.4793	0.2150	1.9326
DE	0.4222	0.3507	-0.0968	-0.8876
FL	-0.6427	-0.5339	-0.1145	-1.0501
GA	-0.5486	-0.4557	-0.0831	-0.7621
HI	0.5204	0.4323	-0.0957	-0.8779
IA	0.4665	0.3875	-0.0708	-0.6498
ID	-0.6941	-0.5766	0.0400	0.3666
IL	0.4933	0.4098	0.0072	0.0660
IN	-0.1462	-0.1215	-0.0561	-0.5143
KS	-0.0016	-0.0013	-0.1341	-1.2300
KY	-0.7128	-0.5921	0.0701	0.6431
LA	1.1196	0.9300	-0.2328	-2.1359
MD	-0.1585	-0.1317	0.0202	0.1857
ME	-0.7213	-0.5992	-0.0193	-0.1770
MI	0.1432	0.1189	-0.0649	-0.5957
MN	0.0969	0.0805	-0.1209	-1.1094
MO	0.1035	0.0859	-0.1007	-0.9234
MS	-0.0234	-0.0194	-0.1565	-1.4354
NC	-0.4147	-0.3445	-0.0128	-0.1172
ND	3.9956	3.3208	-0.4304	-3.9481
NE	-0.1085	-0.0901	-0.1149	-1.0536
NH	0.0238	0.0198	-0.0878	-0.8057
NJ	0.0910	0.0756	0.0518	0.4747
NY	-0.0169	-0.0140	-0.0021	-0.0197
OH	-0.0640	-0.0531	0.0442	0.4053
OR	-0.2168	-0.1801	-0.1214	-1.1133
PA	0.2189	0.1819	-0.0004	-0.0037
RI	-0.5785	-0.4806	0.0667	0.6117
SC	-0.8953	-0.7437	-0.0316	-0.2902
SD	1.3058	1.0847	-0.1559	-1.4305
TN	-0.8849	-0.7351	-0.0040	-0.0366
TX	-0.8497	-0.7059	-0.1237	-1.1345
UT	1.2521	1.0401	-0.2458	-2.2546
VA	-1.2776	-1.0613	-0.0027	-0.0246
VT	0.0091	0.0075	-0.0037	-0.0343
WA	0.0140	0.0117	-0.1803	-1.6539
WI	0.2659	0.2209	0.0437	-0.4009
WV	0.4625	0.3842	-0.0962	-0.8824

$PF460US_t$ = average retail residual oil price for the U.S. from
Form EIA-460

9.2.4 Transportation Sector

In the previous section, the average retail price of No. 6 fuel oil is used as a surrogate for the commercial sector price of residual oil, due to lack of more relevant information. To impute state-level residual oil prices, we have introduced the state price variability observed in the industrial sector.

Review of the available data sources disclosed only one consistent price series specific to transportation use of residual oils: The national average price of Bunker C oils for vessel use from EIA-460. To utilize this information in generating state-specific prices for the transportation sector, an in-depth look at state-level transportation use of residual oils was required. Transportation use of residual oils is mainly composed of vessel bunkering and railroad uses. As shown in Table 9.6, over 99% of total transportation use of residual oils nationwide during the period 1976 through 1979 was accounted for by vessels. There are, however, state and regional variations.

Generally, in coastal states, Great Lakes states, and states along the Mississippi shipping route vessel use of residual oils predominates. States without access to water transport and with major railroads also recorded consistent usage of residual oils. Table 9.6 shows that the states can be grouped into four categories:

Group 1: In 16 states 100% of the transportation use of residual oil is for vessel bunkering purposes; there is essentially no railroad use at all. These states are: Alabama, Alaska, Connecticut, Florida, Georgia, Hawaii, Indiana, Louisiana, Maryland, Minnesota, Mississippi, New Jersey, New York, North Carolina, Ohio, and Rhode Island.

Group 2: 12 states have had some railroad use of residual oils in all or some of the years, but their total use of the fuel was dominated by vessel bunkering. They are: California, Delaware, Maine, Massachusetts, Michigan, Oregon, Pennsylvania, S. Carolina, Texas, Virginia, Washington and Wisconsin.

TABLE 9.6. Residual Oil Use (1000 bbls)

States	Vessel Bunkering				Railroads			
	1976	1977	1978	1979	1976	1977	1978	1979
Group 1:								
Alabama	6893	6968	6816	3553				
Alaska	850	1150	1963	309				
Connecticut	637	422	428	50				
Florida	2839	3338	3934	11,194				
Georgia	585	379	478	3484				
Hawaii	1191	1077	1323	1237				
Indiana	284	275	169	102				
Louisiana	16,785	18,646	18,725	21,629				
Maryland	2692	2546	3163	4131				
Minnesota	479	159	488	354				
Mississippi	1231	1303	2200	2704				
New Jersey	5818	6480	7089	7615				
New York	7889	6631	6024	11,198				
N. Carolina	156	94	87	100				
Ohio	922	638	645	720				
Rhode Island	2	11	20	100				
Group 2:								
California	29,119	35,893	50,125	47,808	7	9	12	9
Delaware	924	753	729	549	12	-	-	-
Maine	936	541	337	697	11	2	7	2
Massachusetts	1095	1089	777	946	2	-	4	-
Michigan	273	277	228	155	5	-	-	23
Oregon	357	399	1833	3773	-	2	-	1
Pennsylvania	3994	4805	4040	4728	40	23	-	10
S. Carolina	669	396	595	747	7	9	8	6
Texas	25,687	30,002	37,549	49,549	75	52	75	76
Virginia	2392	1793	1664	4181	18	17	13	4
Washington	2284	2576	5554	8721	1	1	-	-
Wisconsin	378	322	477	287	26	24	24	41
Group 3:								
Colorado	-	-	-	-	3	7	3	3
Iowa	-	-	-	-	19	13	7	-
Kansas	-	-	-	-	21	38	22	26
Missouri	4	2	2	-	42	31	11	2
Nebraska	-	-	-	-	36	26	5	14
Wyoming	-	-	-	-	54	45	1	8
Exception:								
Illinois	91	4	30	-	33	26	9	19
Group 4:								
Arizona, Arkansas, District of Columbia, Idaho, Kentucky, Montana, Nevada, New Hampshire, New Mexico, N. Dakota, Oklahoma, S. Dakota, Tennessee, Utah, Vermont, W. Virginia.								

Source: EIA, Deliveries of Fuel Oil and Kerosene.

Group 3: There are six (6) states with very little or no, reported vessel bunkering use of residual oils; all transportation use of the fuel can be attributed to railroads. These states are: Colorado, Iowa, Kansas, Missouri, Nebraska, and Wyoming.

Group 4: Except for Illinois, the other 16 states had no, or negligible, use of residual fuel for transportation purposes: Arizona, Arkansas, District of Columbia, Idaho, Kentucky, Montana, Nevada, New Hampshire, New Mexico, North Dakota, Oklahoma, South Dakota, Tennessee, Utah, Vermont, West Virginia.

Illinois is the exception to the four groupings because roughly equal volumes of both vessel and railroad use of residual oil were reported. For this reason, Illinois will be treated separately in the imputation process.

Given the above discussion, it is reasonable to make the following assignments of price data:

Groups 1 & 2: Since transportation uses of residual oil in states included in these two groups are either entirely composed of (Group 1) or dominated by (Group 2) vessel bunkering, Bunker C prices will be used to represent transportation sector prices of residual oil.

Group 3: Since transportation use of residual oil in states included in this group is entirely by railroads, the commercial sector price of residual oil will be assigned to the transportation sector.

Group 4: Since there is little or no recorded transportation use of residual oils in these states, there is no need to develop a transportation sector price for residual oil.

Illinois: Since vessel bunkering and railroad uses of residual oils are both significant in the state's transportation use of residual oils, the price will be the volume-weighted average of the Bunker C and commercial sector prices.

Step 1. Given the above discussion, the following general equation is applicable to states in Groups 1 and 2.

$$PTXX_t = PCXX_t (PBCUS_t \div PCUS_t) \quad (9.4)$$

Where:

PXX_t = residual oil price, representing Bunker C fuel, for the transportation sector in state XX, in year t

$PBCUS_t$ = the U.S. price of Bunker C fuel from Form EIA-460

$PCXX_t$ = the residual oil price for the commercial sector in state XX, in year t

$PCUS_t$ = residual oil price for the U.S. from

Step 2. For states in Group 3, the transportation sector price is equal to the commercial sector price.

$$PXX_t = PCXX_t \quad (9.5)$$

Step 3. For Illinois, the following equation is used to calculate the transportation sector price ($PCIL_t$).

$$PCIL_t = (WBC_t)(PBCIL_t) + (1-WBC_t)(PCIL_t) \quad (9.6)$$

Where:

$PCIL_t$ = residual oil price for the commercial sector for Illinois in year t.

$PBCIL_t$ = the Bunker C price for Illinois in year t calculated in Equation 9.4

WBC_t = the average proportion of transportation use of fraction of residual oil in the State of Illinois accounted for by vessel bunkering from EIA's Deliveries of Fuel Oil and Kerosene.

Step 4. Calculate the weighted average national price (PUS_t) using volume weights from SEDS.

$$PUS_t = \frac{\sum_{XX=1}^{51} (PXX_t \cdot SVXX_t)}{\sum_{XX=1}^{51} SVXX_t} \quad (9.7)$$

Where:

$SVXX_t$ = volume of residual fuel use in the transportation sector reported in SEDS for state XX in year t

9.3 RECOMMENDATIONS

The most complete time series of state-level data available is for the electric utility sector. We recommend that this residual fuel price data from Cost and Quality of Fuels for Electric Utility Plants be used and that prices for 1970-1972 be developed by linking data from the EEI Statistical Year Book to the Cost and Quality data. For the industrial sector, the Census of Manufactures and the Annual Survey of Manufactures are the best state-level data sources. We recommend that these data sources be adopted for 1971, and 1974 through 1979. We further recommend that imputation of the missing data for earlier years be carried out by linking these data to the national average data from EEI and that preliminary estimates be derived for 1980 by the average apparent percentage markup approach explained in Section 9.2.2.

The imputation recommended for the commercial sector is based on the national data from EIA-460 and the state-level prices derived for the industrial sector. Commercial sector prices are then used in turn to impute transportation sector prices. These are developed from the national average prices of Bunker C and residual oil from EIA-460.

9.4 SUMMARY OF AGENCY COMMENTS

Two points were raised in the formal EIA review of the draft working paper on residual fuel prices.

1. It was pointed out that another source of residual fuel oil prices, EIA-194 "Monthly Alternate Fuel/Incremental Price Monitoring Report," was not included in the draft working paper. This source provides estimates of the volume-weighted average delivered price of high sulfur No. 6 fuel oil in large lot sales to industrial customers. The data collection effort started in November, 1979. It was suggested that this data may be as an alternative used in the industrial sector estimation scheme.

Response: We agree that the EIA-194 data could be a useful alternative in Step 2 of the industrial sector price imputation process. However, the time series presently available is too short to

be useful in this data base development process. We recommend that this data source be studied in the data base updating process for possible incorporation into the methodology.

2. The price imputation procedures for the commercial sector residual fuel prices and transportation sectors were questioned. Specifically, the pyramiding of the transportation price on commercial price which, in turn, depends upon the industrial sector prices may significantly affect the quality of the estimates.

Response: We recognize the weaknesses of the pyramiding approach. However, given the extremely limited availability of data and the requirements of the data base, the recommended approach was practical.

9.5 NOTES ON IMPUTATION OF INDUSTRIAL AND COMMERCIAL SECTOR PRICES

In the draft working paper on residual fuel price series we proposed certain imputation procedures which have been substantially modified in implementation. Due to the length of these considerations, they are included here in this section so as not to interrupt the discussion in the text.

9.5.1 Industrial Sector

The original procedure was as follows:

Estimate the following equation by regression, linking national retail residual prices from the EIA-460 data and the ASM and CM data (PXX_t) available for the years 1975 through 1978 for the 50 states and the District of Columbia.

$$\begin{aligned}
 PXX_t = & a + b \cdot PRUS_t + \sum_{XX=1}^{19} d_{XX} \cdot DSXX + \sum_{XX=21}^{51} d_{XX} \cdot DSXX \\
 & + \sum_{XX=1}^{19} g_{XX} (PRUS \cdot DSXX) + \sum_{XX=21}^{51} g_{XX} (PRUS \cdot DSXX) \quad (9.8)
 \end{aligned}$$

Where:

$PRUS_t$ = average U.S. retail residual price in year t.

DSXX = dummy variable for state XX; state 20, Massachusetts, is taken as the point of departure, and so is not included in the equation.

After deriving the parameter estimates for the equation, it is used, in conjunction of the national retail prices from EIA-460, to estimate industrial prices since 1978 and enter them in the data base.

9.5.2 Commercial Sector

Two assumptions were made:

1. The proportional relationship between state-level residual oil prices and national residual oil prices is the same for the commercial sector as for the utility sector.

2. The best state-level residual oil price data are the data from Cost and Quality of Fuels for the electric utility sector.

Given these two assumptions, the general equation for deriving state-level residual oil prices for the commercial sector is as follows:

$$PCXX_t = PCQXX_t (PF460US_t \div PCQUS_t) \quad (9.9)$$

Where:

$PCXX_t$ = commercial sector residual oil price in state XX, in year t

$PCQXX_t$ = residual oil price for state XX for the electric utility sector from Cost and Quality

$PF460US_t$ = average retail residual oil price for the U.S. from EIA-460

Step 1. For 1976 to 1980, when EIA-460 data are available, substitute the appropriate data in Equation 9.9 to calculate the commercial price.

Step 2. For 1975 and earlier, the proportionality factor (second term on the right-hand side of Equation 9.9) can be approximated by the average of the terms for the 1976-1980 period.

Step 3. For some states, there may not be Cost and Quality data because there were no residual oil transactions involving the states' electric utilities. For these states, this term can be estimated by the following expression:

$$PCQXX_t = PASMXX_t (PCQUS_t \div PASMUS_t) \quad (9.10)$$

Where:

$PASMXX_t$ = residual oil price for the industrial sector developed from the Annual Survey of Manufactures and Census of Manufactures.

10. LIQUEFIED PETROLEUM GAS

Liquefied petroleum gas (LPG) refers to the gases produced by oil refineries, including propane, butane, isopentane, isobutane, propylene, butylene, and plant condensate. Ethane, which is a liquefied gas produced by natural gas processing plants, is usually not included in the definition of LPG. However, since it is often used in a manner similar to LPG, it is included in the LPG price series.

LPG is used in the residential, commercial, industrial, and transportation sectors. The residential and commercial sectors use it for space heating, cooking, and water heating. The industrial sector uses it for space heating, as a standby fuel, and other specialized uses like flame cutting, metallurgical furnaces, and plumber's torches. LPG is consumed as internal combustion fuel for use in tractors, irrigation engines, highway vehicles of all kinds, fork-lifts and other industrial tractors, and also for oilfield drilling and production equipment. Other uses of LPG include agricultural uses, synthetic natural gas feedstock, and for use in secondary recovery projects. In 1979, LPG supplied 2.7 percent, (2.14 Quads), of the total U. S. energy consumption of 79 Quads. Of the total 2.14 Quads of LPG, residential and commercial sector accounted for 25 percent; industrial sector, 74 percent; and transportation sector, 1 percent (DOE 1980a, p. 68).^(a)

In 1979, the composition of LPG use was as follows: Propane, 58 percent; butane, 9 percent; propane-butane mixtures, 1 percent; and ethane 32 percent (DOE 1980d). Note that, while propane is used in the residential, commercial, industrial and transportation sectors, ethane is used only in the industrial sector.

(a) There are some discrepancies between the figures contained in the ARC, SEDS, and Sales of Liquefied Petroleum Gases and Ethane in 1979. These discrepancies could be due to differences in groupings and definitions. No attempt was made to reconcile them in this writing.

10.1 DATA BASE REVIEW

A working list of published sources of LPG prices was compiled from: The American Gas Association's (AGA) Energy Statistics: North American and World Sources, 1977; the Ideamatics, Inc. report, Federal Energy Data System Analysis and Evaluation, 1978; the Energy Information Administration's EIA Publications Directory, 1980; and a search of bibliographies of energy-related publications. Preliminary examination of the identified sources of LPG price data narrowed the field of candidate data bases to six that met or nearly met the established review criteria. Listed in Table 10.1 by source organization, these six data sources were evaluated in depth as potential sources for the EIA liquefied petroleum gas price series. Among sources reviewed and determined unsuitable for EIA use were the Oil Daily, Oil and Gas Journal, and Journal of Commerce. These sources published secondary data or published prices collected for a severely limited sample.

The characteristics of the six candidate LPG data bases are compared in Table 10.2. Three of the data bases, Gas Househeating Survey, Annual Survey of Manufactures, and Agricultural Prices, contain end-use LPG prices from which state-level price estimates can be generated. Five of the data sources had minimal imputation of missing data and five publish the data within 10 months of the close of the reporting year.

TABLE 10.1. Candidate Sources of LPG Price Data

<u>Organization</u>	<u>Publication</u>	<u>Forms Used</u>
American Gas Association	<u>Gas Househeating Survey</u>	
Department of Agriculture	<u>Agricultural Prices</u>	OMB #40-R 1906
Energy Information Administration	<u>Monthly Petroleum Product Price Report</u>	EIA-460
McGraw-Hill, Inc.	<u>Platt's Oil Price Handbook and Oilmanac</u>	
Butane Propane News, Inc.	<u>Butane Propane Newsletter</u>	
Bureau of Labor Statistics	<u>Annual Survey of Manufactures</u>	MA-100

TABLE 10.2. Comparison of LPG Price Data Bases

<u>Characteristics</u>	<u>AGA</u>	<u>USDA</u>	<u>EIA</u>	<u>Platt's</u>	<u>BPN</u>	<u>ASM</u>
Definition of LPG						
Propane	+	-	-	-	+	-
LPG, including ethane	-	+	+	-	-	-
LPG, excluding ethane	-	-	-	+	-	+
Sectoral coverage						
Residential	+	-	-	-	-	-
Commercial	-	-	-	-	-	-
Industrial	-	+	-	-	-	+
Transportation	-	-	-	-	-	-
State-level estimates	+	+	-	-	+	+
Timely availability	+	+	+	+	+	-
Minimal missing data	+	+	+	+	-	+

+ = Yes or Available

- = No or Not Available

The American Gas Association collects propane prices reported by member gas utilities as the competitive price of propane for residential heating use. Average delivered prices in dollars per million Btu are reported by utility, city, and Census Region. States for which no data are reported vary from year to year. The AGA questionnaire is voluntarily submitted each year by AGA members who comprise the sample of about 155 gas utilities. The responding sample size varies yearly, and the number of published responses per state has declined over time. Responses to the survey are in dollars per gallon but are converted to dollars per million Btu for publication. The AGA has been collecting competitive prices since 1971. Since then, there have been no major changes in collection methods. Data are compared to an expected range of values and suspect figures are rechecked; any missing data are marked "NA". The lag to publication generally does not exceed nine months.

Although Gas Househeating Survey contains fairly good residential sector LPG prices, there are some important considerations to be made if these data are to be used in the EIA price series. First, there is some imprecision in the method of data collection; the method by which each utility ascertains its competitor's prices is undocumented. The sample of responding utilities is

also inconsistent from year to year, and has decreased by about half since 1971. Second, prices collected are not volume weighted by the AGA, and weights are not readily available. Third, a 14-month delay in publication developed for the 1980 edition. It is not known at this time if the time lag to publication will remain at 14 months or be reduced to the shorter lag of earlier publications.

Industrial sector LPG prices are compiled by the U.S. Department of Commerce, Bureau of the Census using Form MA-100 and are published in the Annual Survey of Manufactures (ASM). The ASM contains delivered cost and quantity data from which state-level prices can be calculated. LPG prices are available since 1978 from the ASM. Completion of form MA-100 is required of 70,000 manufacturing companies which represent firms with more than 250 employees and some smaller firms, added to constitute a probability sample. MA-100 is collected annually and data are verified by computer and analytical checks for consistency with historic trends and current industry patterns. No imputations are done for missing data and there have been no changes in data collections procedures.

Although the quality of the ASM data is adequate for use in the STEPS, the Bureau of the Census has not been able to keep the lag to publication under one year. At present, data are available for 1978 and 1979. In addition, because the data only cover the manufacturing industries, the entire industrial sector is not covered.

The Crop Reporting Board of the U.S. Department of Agriculture publishes LPG prices in Agricultural Prices. These LPG prices are the prices farmers paid for LP gas and are collected on the form, "Prices Paid by Farmers for Petroleum Products, Motor Supplies, and Services." Prices are average bulk delivery prices measured on the 15th day of the reporting month. LPG is not specifically defined on the form, so it is likely that farmers report all liquefied gases purchased, including ethane. Agricultural Prices began publishing state-level LPG prices prior to 1970.

Approximately 3000 farmers participate in the voluntary survey. State samples are selected by the Crop Reporting Board state offices, so criteria for sample selection vary somewhat from state to state. All states use the same form, however, and many states augment the mailed questionnaire with a telephone follow up. There have been no major changes in the method of data

collection and missing data are marked "not available." Submitted data are validated by a check of anomalous figures. Collection forms are distributed and collected monthly, and the lag to publication is usually 6 months for the annual summary.

Farm use of LPG is usually considered to be industrial sector use. It should be recognized, however, that the Agricultural Prices data provide a limited representation of the industrial sector and some portion of the product use is probably residential in nature. The lack of definition of LPG on the data collection form causes doubt as to the proportions of each fuel type used, so that it is difficult to assess biases in the product representation of the series. There are also some doubts as to the sample representation in each state since the state Crop Reporting Boards merely submit whatever data are reported by the survey respondents.

The remaining three LPG price data sources do not specify end-use sectors and two do not publish state-level prices. The Energy Information Administration collects LPG price data on form EIA-460, "Petroleum Industry Monthly Report for Product Prices." The EIA-460 series began in 1975 on form FEA-P302-M-1, which was later replaced by EIA-460. Monthly weighted average selling prices in dollars per gallon are collected for all specific LPG fuel types, including ethane. Although collected at the company level, data are published only at the national level, appearing in Monthly Petroleum Product Price Report and Monthly Energy Review.

EIA-460 is sent monthly to about 1120 firms which derive \$50 million or more in annual sales revenues from covered products. Participation in the survey is mandatory. A form change, which took place in September 1980, did not affect sample selection or the responses collected. Respondent firms are contacted if data are missing; if data are not available the designation "NA" is used. Data submitted are validated by checks of suspect responses. There is a 5-month lag to publication for the EIA-460 data published in Monthly Petroleum Product Price Report.

Platt's Oil Price Handbook and Oilmanac was used as the sole source in the development of the existing LPG end-use price series. Platt's, published by McGraw-Hill, contains city-level wholesale prices in cents per gallon. LPG price data published by Platt's do not include ethane. Truck transport, tank

car, and pipeline input prices are collected for up to eleven cities through a daily telephone survey of major refineries, terminals, and pipelines. Response to the survey is voluntary, with the number of reporting terminals increasing slightly over time. Missing data are not imputed, and any anomalous data are rechecked. Consistent data are available since 1970 and the lag to publication for the annual edition of Platt's is less than 10 months.

Posted wholesale propane prices are collected and published by Butane Propane News, Inc. in the Butane Propane Newsletter. Price data are reported by city and by major refiner, and cover about 30 states. Because the prices are wholesale, no end-use sectors are specified. The propane prices in Butane Propane Newsletter have been collected and published weekly since 1975. Both a telephone survey and some mailed survey forms are used to collect the data from major refiners and distributors of propane. Participation is voluntary and no imputation or validation procedures are used. Using this data on a regular basis in the LPG series might require a contractual agreement between the EIA and Butane Propane News, Inc.

10.2 IMPUTATION PROCEDURES

Of the four sectors for which price data were sought, state-level prices are available for all years for the industrial sector and for nine years for the residential sector. In addition to the one year of imputation needed in the residential sector, extensive data imputation would be required to construct an LPG price series for the commercial and transportation sectors. In this section, suggested procedures for construction of the LPG price series are presented for the residential and industrial sectors.

10.2.1 Residential Sector

For 1971 and later years, state-level propane prices are available from the American Gas Association's Gas Househeating Survey. Since nearly all LPG consumed in the residential sector is propane, the AGA prices can be used directly for estimation of LPG residential sector prices. Only missing state data will have to be imputed for these nine years and residential LPG prices for 1970 can be imputed using the Agricultural Prices data. The steps for constructing the residential LPG price series are as follows:

- Step 1. For all available years, assign the city prices in Gas Househeating Survey to the state in which the city is located.
- Step 2. Estimate the state level price (PXX_t) using a straight average of the city prices assigned to each state.
- Step 3. If no city prices are assigned to a state, estimate the state level price (PXX_t) using a straight average of the prices in adjacent states.
- Step 4. To impute prices for 1970, estimate the relationship between Agricultural Prices data and Gas Househeating Survey data from 1971 to 1972:

$$PGHSXX_t = a + b \cdot PAPXX_t \quad (10.1)$$

Where:

$PGHSXX_t$ = price from Gas Househeating Survey for state XX in 1971-1972

$PAPXX_t$ = Price from Agricultural Prices for state XX in 1971-1972

Using pooled 1971 and 1972 data, excluding Alaska and Hawaii, the following the result was derived:

$$PGHSXX_t = 0.2974 + 11.5211 PAPXX_t \quad (10.1a)$$

(1.166) (8.003)

$$R^2 = 0.4002 \quad d.f. = 96$$

- Step 5. Calculate the 1970 prices (PXX_{1970}) from the parameter estimates of Equation 10.1 using the Agricultural Prices data for 1970.
- Step 6. Calculate the U.S. average residential price (PUS_t) by applying volume weights from SEDS ($SVXX_t$) to the state prices (PXX_t).

$$PUS_t = \frac{\sum_{XX=1}^{51} (PXX_t \cdot SVXX_t)}{\sum_{XX=1}^{51} SVXX_t} \quad (10.2)$$

10.2.2 Industrial Sector

The U.S. Department of Agriculture's Agricultural Prices and the Annual Survey of Manufacturers provide state-level data that can be used for the industrial sector. Although the Agricultural Prices data do not reflect the cost of LPG to manufacturing firms, they are bulk delivery prices and they include ethane. Before 1977, the Department of Agriculture collected one LPG price per respondent per year, which represented the purchase price of the most recent LP gas purchase (usually occurring in April, May, or June). Since 1977, prices have been collected every month. An LPG industrial sector price series can be constructed from the Annual Survey of Manufactures and Agricultural Prices data with the following steps:

- Step 1. For 1978 through 1979, use the state-level estimates calculated from the data published in the Annual Survey of Manufactures.
- Step 2. For the years 1970-1977 and 1980 assign state-level prices based on the relationship between the ASM price in 1978 and/or 1979 and the Agricultural Prices price in the same year. Alaska and Hawaii are assigned prices based on the relationship between their state prices in 1978 and 1979 and an unweighted U.S. price. Annual prices from Agricultural Prices are simple averages of the quarterly or monthly published prices.
- Step 3. Missing data for Wyoming are imputed as the average price of adjacent state prices.
- Step 4. Calculate the U.S. average industrial price (PUS_t) by applying volume weights from SEDS ($SVXX_t$) to the state prices (PXX_t).

$$PUS_t = \frac{\sum_{XX=1}^{51} (PXX_t \cdot SVXX_t)}{\sum_{XX=1}^{51} SVXX_t} \quad (10.3)$$

10.3 RECOMMENDATIONS

It is recommended that the EIA price series for liquefied petroleum gas include only the residential and industrial sectors. The residential sector prices would be based on the data from the Gas Househeating Survey with Agricultural Prices data used to impute the LPG prices for 1970. The industrial sector LPG prices would be based solely on the Agricultural Prices data. Since no data have been identified to relate commercial or transportation sector LPG price levels to either the residential or industrial sector, any imputation strategy would be arbitrary. It is recommended, therefore, that no separate price series be maintained for these two sectors. If prices are needed for the commercial or transportation sectors, the bulk delivery industrial sector prices could be used.

10.4 SUMMARY OF AGENCY COMMENTS

Formal EIA review of the draft working paper on LPG prices raised questions of arbitrary of procedures, and of the equivalency of sectoral prices and city-state prices. These issues are briefly explained below:

1. The data series proposed for adoption appeared to be "too arbitrary to be used in an EIA price series or to develop a usable data base of state-level prices."

Response: Given the scope of the work and the requirements of the project as explained in Volume I, Chapter I of this report, the proposed approach and procedures are practical and take advantage of the best information available.

2. Reservations were expressed regarding the use of "agricultural prices" for industrial sector prices and the use of city prices for state prices. Suggestions were made to test the equivalency of such price assignments and to designate the "agricultural prices" as such, instead of industrial prices.

Response: For the years since 1978, the procedure has been changed to use the ASM industrial sector price data. For the years 1970 to 1977, the lack of alternative data sources and the need to develop the individual sector prices at the state level dictated that a practical approach be adopted.

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- U.S. Department of Transportation. Series. Highway Statistics. U.S. Government Printing Office, Washington, D.C.

APPENDIX E

DATA SOURCE COLLECTION FORMS

ELECTRICITY

PUBLICATION TITLE: Statistics of Privately Owned Electric Utilities in the United States

ORGANIZATION: Energy Information Administration

ADDRESS: Washington, D.C. 20461

CONTACT: Sam Brown PHONE NUMBER: (202)252-5146

Data Description: Electricity							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Utility	Revenues/Sales by sector	Residential Small/commercial Large/industrial Public street and highway lighting Other public authorities Railroads and railways Interdepartmental	Mailed survey using FPC Form 1	About 210 utilities	Class A and B Utilities	Mandatory
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Corrections of data errors identified by EIA are filed but not published.		No imputation.	Annual	Since 1936	About 9 months	Utilities are listed by the state from which most of their revenues are drawn. Utility data is not aggregated by state.

PUBLICATION TITLE: Statistics of Publicly Owned Electric Utilities in the U.S.

ORGANIZATION: Energy Information Administration

ADDRESS: Washington, D.C. 20461

CONTACT: Sam Brown

PHONE NUMBER: (202)252-5146

Data Description: Electricity							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Municipalities, federal projects	Revenues/sales by sector	Residential Small/commercial Large/industrial Other ultimate consumers	Mailed questionnaire ERA Form 412, formerly FPC Form 1M	About 500 utilities 80 federal projects	Operating revenue greater than \$250,000 per year	Mandatory
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Form simplified in 1961	Anomalous data are checked. Revisions are filed but not published.		No imputation	Annual	Since 1946	About 9 months	Data for federal projects cannot be allocated by state from this information. Municipalities are listed by state but are not aggregated. FPC will not require reports from federal projects after 1980 but ERA may collect data.

PUBLICATION TITLE: Electric Power Statistics
 ORGANIZATION: Energy Information Administration
 ADDRESS: Washington, DC 20461
 CONTACT: Thomas F. Woods PHONE NUMBER: (202)252-5221

Data Description: Electricity							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	State	kWh sales, revenues	Residential Commercial Industrial Other	Survey FERC Form 5	130 large private utilities 20 municipals and smaller private utilities	Utilities with sales over \$100 M plus smaller utilities in some regions Coverage of 83% of industry sales	Mandatory - private Voluntary - public
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
			Reported kWh data is "expanded" based on annual data from FERC Form 12	Monthly	5 yrs on computer tape		Revenue data is not published by state because of missing data. All data collected is on tape.

PUBLICATION TITLE: Statistical Year Book of the Electric Utility Industry

ORGANIZATION: Edison Electric Institute

ADDRESS: 1140 Connecticut Avenue N.W., Washington, D.C. 20036

CONTACT: Thomas Daugherty PHONE NUMBER: (202)828-7454

Data Description: Electricity							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	State	Revenues/sales by sector, excluding taxes	Residential Commercial Industrial Street and highway lighting Other public authorities Railroads and railways	Mailed questionnaire Uniform Statistical Report - Annual	320 state utility operations	Utilities represent about 97% of total population	Voluntary
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Crosschecking of monthly with annual data		No missing data at the State level	Annual, with sub-sample monthly	About 20 years	10 to 13 months for annual data	Data may be available by March if some reprogramming is done. Utilities report their operations in each state separately. Rural customers are added to residential or commercial classes. Fuel adjustment figures are allocated to sectors.

PUBLICATION TITLE: Consumer Prices: Energy

ORGANIZATION: U.S. Department of Labor, Bureau of Labor Statistics

ADDRESS: Washington, DC 20212

CONTACT: Lawrence Prete (EIA) PHONE NUMBER: (202)252-6535
Sharon Gibson (BLS) (202)272-5177

Data Description: Electricity							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	28 Cities and 4 regions, also by city size class in each region	Price for 500 kwh, also average \$/kwh, price is as of 15th of each month and includes taxes and fees.	Residential	Mailed questionnaire Form EIA-101	85 SMSA's	Following CPI practices	Mandatory
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Sample size increased in 1978 from 56 to 85 SMSA's	Rate changes are calculated by EIA and compared to reported figures. Spot checking also takes place.		Figures are held constant from the previous period or are marked NA Data are rarely missing	Monthly, since 1978	Since early 1960's	3 to 4 weeks	The sample does not cover all regions equally well, and there are no data for some states.

PUBLICATION TITLE: Producer Prices and Price Indexes

ORGANIZATION: U.S. Department of Labor, Bureau of Labor Statistics

ADDRESS: Washington, D.C. 20212

CONTACT: Sarah Cohen

PHONE NUMBER: (202)272-5210

Data Description: Electricity							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Census region	Price index and price per 10,000 kWh	Commercial Industrial	Mailed questionnaire, Form EIA-101		Utilities serving 85 SMSAs in survey	Voluntary
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Sample size increase in 1978	Revisions occur 4 months after original publication DOE verifies changes larger than 10%		None	Monthly	Since 1967	One month	Commercial sector is defined as 40 kWh demand Industrial sector is defined as 500 kWh demand

PUBLICATION TITLE: Annual Survey of Manufactures, Census of Manufactures

ORGANIZATION: U.S. Department of Commerce, Bureau of the Census

ADDRESS: Washington, D.C. 20233

CONTACT: Dennis Wagner

PHONE NUMBER: (202)763-5116

Data Description: Electricity							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	State, SIC code	Million kwh purchased and delivered cost (million \$)	Industrial	Mailed survey, form MA-100 (MU)	70,000 manufacturing companies	Probability sample	Mandatory
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Computer and analytical checks for consistency		None	Annual	Since 1950	Over 1 year	

PUBLICATION TITLE: Gas Househeating Survey

ORGANIZATION: American Gas Association

ADDRESS: 1515 Wilson Boulevard, Arlington, VA 22209

CONTACT: Larry Murphy PHONE NUMBER: (703)841-8492

Data Description: Electricity							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Utility, city	Prices for total electric or rate prevailing for 600 kWh per month and above (\$/MMBtu)	Residential	Mailed questionnaire	About 155 natural gas utilities	AGA members	Voluntary
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Data are compared with expected range and suspect figures are checked		Missing data are marked "NA"	Annual	Since 1971	Up to 9	Sample size varies greatly Data prior to 1971 may be available from AGA files

PUBLICATION TITLE: Typical Electric Bills

ORGANIZATION: Energy Information Administration

ADDRESS: Washington, D.C. 20461

CONTACT: Lawrence Prete PHONE NUMBER: (202)252-6535

Data Description: Electricity							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Utility, city	Billing rates as of January 1 for a range or consumption levels(a)	Residential Commercial Industrial	Mailed questionnaire with telephone follow-up	All utilities serving 6,700 cities, about 70% of U.S. population.	Cities of population over 2,500 (residential) Cities of population 50,000 or more (commercial and industrial)	Mandatory
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Results of rate changes are calculated and compared to reported figures; anomalous data are rechecked		No missing data	Annual	Since 1942	About 1 year	State average bills are given for the residential sector, but not for the commercial or industrial sectors. (a) Residential: 100, 250, 500, 750, 1000 kWh Commercial: 375, 750, 1500, 6000, 10,000 kWh corresponding to five kW demand levels Industrial: 2 kWh categories for each of five kW demand levels

NATURAL GAS

PUBLICATION TITLE: Natural Gas Production and Consumption

ORGANIZATION: Energy Information Administration

ADDRESS: Washington, DC

CONTACT: Gordon Koelling PHONE NUMBER: (202)252-6305

Data Description: Natural Gas							
Geographic Scope	Level of Aggregation	Definition of Price/Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/Mandatory Reporting
U.S.	State	Revenues/quantity including taxes	Residential Commercial Industrial Electric Utilities Other Consumers(a)	Mailed Survey BOM Forms 1340A and 1341A now EIA Form 176 	Universe (over 1600 respondents)	Gas distributors and other delivering gas for end use	Voluntary through 1979, mandatory beginning in 1980.
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
			Imputation from various other sources of information used for nonrespondents	Annual	1960 to present Pipeline fuel since 1968	Available by October	Utility data is taken from FERC Form 4 (a) includes municipalities and public authorities Data for Btu content is collected on Form 176 but not used in calculating price/quantity.

PUBLICATION TITLE: Gas Househeating Survey

ORGANIZATION: American Gas Association

ADDRESS: 1515 Wilson Boulevard, Arlington, VA 22209

CONTACT: Larry Murphy PHONE NUMBER: (703)841-8492

Data Description: Natural Gas							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Utility, city	Prices exclude base-load (\$/MMBtu)	Residential, including single-metered multi-family units using gas for space heating	Mailed questionnaire	About 155 gas utilities	AGA members	Voluntary
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Data are compared with expected range and suspect figures are checked		Missing data are marked "NA"	Annual	Since 1971	Up to 9 months	Sample size varies yearly Data prior to 1971 may be available from AGA files

PUBLICATION TITLE: Gas Facts

ORGANIZATION: American Gas Association

ADDRESS: 1515 Wilson Boulevard, Arlington, VA 22209

CONTACT: Forest Schmelling PHONE NUMBER: 841-8502

Data Description: Natural Gas							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	State	Average price and revenue/sales	Residential Commercial Industrial Other(a)	Mail Survey	400 utilities	1400 utilities, all AGA members	Voluntary
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Suspect figures are checked		Some estimation of missing data	Annual	Since early 1950s	6 months	Data for utilities are available (a) Gas used in electrical generation is included in "other" prior to 1976 and "industrial" from 1976 on.

PUBLICATION TITLE: Cost and Quality of Fuels for Electric Utility Plants

ORGANIZATION: Energy Information Administration

ADDRESS: Washington, D.C. 20461

CONTACT: Kenneth McClevey PHONE NUMBER: (202)252-5310
Richard Salkov (202)252-6522

Data Description: Natural Gas							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	State	Average delivered prices both in \$/MCF and \$/MMBtu	Electric Utility	Mailed questionnaire FPC Form 423	280 electric utilities	Plants with generating capacity of at least 25 megawatts	Mandatory
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Minor form modifications October 1974 January 1977	Manual audit and a computer audit		Weighted averages of previous values	Monthly	Since 1973	5 months for annual publication	Monthly data are also published.

PUBLICATION TITLE: Consumer Prices: Energy

ORGANIZATION: Bureau of Labor Statistics

ADDRESS: Washington, DC 20212

CONTACT: Sharon Gibson PHONE NUMBER: (202)272-5177

Data Description: Natural Gas							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	28 cities and 4 regions, also by city size class in each region	Average cost including taxes and fees at 40 therms and 500 therms, also volume weighted average \$/therm	Residential, no multi-family units	Field agents contact utility representatives	85 SMSA's	Following CPI practices	Voluntary
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Sample size increase in 1978 from 56 to 85 SMSA's	Random spot check, anomalous figures are rechecked		Data rarely missing; marked NA or previous data are carried forward	Monthly	Since early 1970's	3 to 4 weeks	The sample does not cover all regions equally well, and there are no data for some states. Earlier data is available for a smaller sample. For Hawaii, gas is propane or bottled gas.

PUBLICATION TITLE: Producer Prices and Price Indexes

ORGANIZATION: U.S. Department of Labor, Bureau of Labor Statistics

ADDRESS: Washington, D.C. 20212

CONTACT: Sarah Cohen

PHONE NUMBER: (202)272-5210

Data Description: Natural Gas							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Census region	Price indexes and prices (\$/MCF)	No end-use sectors	Mailed questionnaire			Voluntary
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Sample size increase in 1978	Revisions occur 4 months after original original publication		None	Monthly	Since 1975	One month	

PUBLICATION TITLE: Annual Survey of Manufactures, Census of Manufactures

ORGANIZATION: U.S. Department of Commerce, Bureau of the Census

ADDRESS: Washington, D.C. 20233

CONTACT: Dennis Wagner PHONE NUMBER: (202)763-5116

Data Description: Natural Gas							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	State, SIC code	Billion CF purchased and cost (Million \$)	Industrial	Mailed survey, Form MA-100 (MU)	70,000 manufacturing companies	Probability sample	Mandatory
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Computer and analytical checks for consistency		None	Annual	Since 1950	Over 1 year	

PUBLICATION TITLE: Statistics of Interstate Natural Gas Pipeline Companies

ORGANIZATION: Energy Information Administration

ADDRESS: Washington, D.C. 20461

CONTACT: Sam Brown
Jim McCarrick

PHONE NUMBER: (202)252-5146
(202)252-6198

Data Description: Natural Gas							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Company	Revenues/sales by sector, given as average price per MCF	Residential Small/commercial Large/industrial Sales to other public authorities Interdepartmental	Mailed questionnaire, FERC Form 2, formerly FPC 2	About 83 gas companies	Class A and B gas companies	Mandatory
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	On-site audits and "desk reviews"		No missing data	Annual	Since 1972	About 1 year	Companies are neither listed nor aggregated by state The geographic location of sales cannot be identified from this data Data do not provide comprehensive or representative coverage of end-use sales

PUBLICATION TITLE: Steam-Electric Plant Construction Cost and Annual Production Expenses

ORGANIZATION: Energy Information Administration

ADDRESS: Washington, D.C. 20461

CONTACT: Larry Prete

PHONE NUMBER: (202)252-6535

Data Description: Natural Gas							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Plant	Prices per MCF and per MMBtu	Electric Utility	Mailed survey, FERC Form 1 and ERA Form 412, formerly FERC Form 1M	632 steam-electric plants	Company size	Mandatory
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Staff review for consistency		None	Annual	Since 1938	9 months	Some data are also drawn from FERC Form 12 and FERC Form 4; however, all price data are collected from FERC Form 1 and ERA Form 412.

COAL

PUBLICATION TITLE: Gas Househeating Survey

ORGANIZATION: American Gas Association

ADDRESS: 1515 Wilson Blvd., Arlington, VA 22209

CONTACT: Larry Murphy

PHONE NUMBER:(703)841-8492

Data Description: Coal							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U. S.	City	\$/10 ⁶ Btu as of December 31	Residential	Mailed survey	About 150-160	Gas distributors	Voluntary
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Change from physical units to Btu in 1973	Consistency check		None	Annual	1971-1977	Up to 9 months	No coal data collected after 1977 due to decline in residential coal usage

PUBLICATION TITLE: Cost and Quality of Fuels for Electric Utility Plants

ORGANIZATION: Energy Information Administration

ADDRESS: Washington, DC 20461

CONTACT: Dean Fennel
Richard Salkov

PHONE NUMBER: (202)252-6523
(202)252-6525

Data Description: Coal							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U. S.	State	\$/10 ⁶ Btu contract \$/10 ⁶ Btu spot \$/10 ⁶ Btu vol. wtd. avg.	Utility	Mailed survey FPC Form 423	280 electric utilities	All plants in the over 25 MW capacity	Mandatory
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Change from quarterly to monthly collection in 1973	Telephone check on anomalous data		Weighted average of previous values	Monthly	Since 1972	4 to 10 months	Information is collected on quantity of anthracite, bituminous, sub-bituminous and lignite used, and on percent sulfur and ash content

PUBLICATION TITLE: Unpublished

ORGANIZATION: Energy Information Administration

ADDRESS: Washington, D.C. 20585

CONTACT: Robert Harris PHONE NUMBER: (202)252-2982

Data Description: Coal							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Manufacturing plant (a)	Total cost and quantity for spot and contract purchases	Industrial ^(b)	Mailed survey, EIA Form 3	About 1000 manufacturing plants	All plants consuming over 200 tons of coal annually	Mandatory
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Change from monthly to quarterly collection in 1980	None		None	Quarterly		Unpublished	Information is collected on lignite, anthracite, bituminous and sub-bituminous coal used. (a) Disclosure problems exist when 3 or less plants comprise a reporting area. (b) Some institutions may be included.

PUBLICATION TITLE: Annual Survey of Manufacturers, Census of Manufacturers

ORGANIZATION: U.S. Department of Commerce, Bureau of the Census

ADDRESS: Washington, D.C. 20233

CONTACT: Dennis Wagner PHONE NUMBER: (202) 763-5116

Data Description: Coal, Coke							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U. S.	2 and 3 digit SIC code, state	Quantity in tons, total cost in dollars	Industrial	Form MA-100 (MU) mailed survey	70,000 firms	Random sample from population of 300,000 firms with more than 250 employees	Mandatory
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Consistency checks, verification of anomalous data		No imputation	Annual	Since 1974 except for coke and breeze which is consistent since 1976	over 1 year	Delivered costs are reported for 1) bituminous coal, lignite and anthracite and 2) coke and breeze. No Btu information is collected.

PUBLICATION TITLE: Coke and Coal Chemicals

ORGANIZATION: Energy Information Administration

ADDRESS: Washington, D.C. 20585

CONTACT: Robert E. Harris PHONE NUMBER: (202)252-2982

Data Description: Coal, coke							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	State	Total value and quantity of coal carbonized; average prices given in \$/000 short tons	Industrial (coke producers)	Mailed survey, EIA-5 and EIA-5A, formerly BOM 6-1370-A	59 coke plants	All coke plants	Mandatory
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Monthly data collection changed to quarterly in 1981 Form revision in 1980	Staff review for consistency		None	Monthly, annual	Since 1970	3 months	

PUBLICATION TITLE: Producer Prices and Price Indexes

ORGANIZATION: U.S. Department of Labor, Bureau of Labor Statistics

ADDRESS: Washington, D.C. 20212

CONTACT: Robert Woodson PHONE NUMBER: (202)272-5210

Data Description: Coal, Coke							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Census Region (coal) City (coke)	FOB mine-month (coal) FOB coke plant (coke) \$/ton	No end-use sectors ^(a)	Mailed questionnaire, telephone calls, site visits by PPI agents	Anthracite: 11-12 mines Bituminous: 18-20 mines Coke: 6 coke producers	Probability sample with additions to insure adequate regional representation	Voluntary
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Sample change planned for 1982	Large changes (over 10%) from previous figures are rechecked		Previous figures substituted for missing data	Monthly	Since 1967	1 month	Price data are of the first Tuesday after the 13th of each month ^(a) Coal prices are reported by coal type and size generally used in the utility, industrial, and retail sectors.

PUBLICATION TITLE: Steam-Electric Plant Construction Cost and Annual Production Expenses

ORGANIZATION: Energy Information Administration

ADDRESS: Washington, D.C. 20461

CONTACT: Larry Prete PHONE NUMBER: (202)252-6535

Data Description: Coal							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U. S.	Plant	\$/10 ⁶ Btu, delivered yearly average	Electric Utility	Mailed survey, FERC Form 1 and ERA Form 412 (previously FERC form 1-M	632 fossil fuel, steam-electric plants	Plants with over 25 MW capacity	Mandatory
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
No	Staff review for consistency		None	Annual	Since 1938	9 months	Some data is also drawn from FERC Form 12 and FERC Form 4. However, all price data is collected from FERC Form 1 and ERA Form 412

DISTILLATE FUEL OIL

PUBLICATION TITLE: Prices and Margins of No. 2 Distillate Fuel Oil

ORGANIZATION: Energy Information Administration

ADDRESS: Washington, D.C. 20461

CONTACT: Annie Whatley

PHONE NUMBER: (202)252-6612

Data Description: Distillate							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	State, DOE Region	Volume-weighted average price \$/gallon	Residential Industrial Institutional/Utility Other	Mailed questionnaire, EIA-9A, formerly EIA-9, FEA-P112-M-1, and CLC-92	About 3000 company-state units (1800 individual companies)	Retailers/resellers of No. 2 distillate randomly chosen from stratified sampling frame	Mandatory
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
No. 2-D diesel fuel added when EIA-9 was replaced with EIA-9A	Selective audits Minimum of five firms in each stratum; no one firm can have more than 40% of weight in a cell		None	Monthly	Since 1975	45 days	Definition of distillate includes No. 2 fuel oil and No. 2-D diesel

CONTACT: Kenneth McClevey PHONE NUMBER: (202) 252-5310
Richard Salkov (202) 252-6522

Data Description: Distillate							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	State	Average delivered prices ¢/10 ⁶ Btu \$/barrel	Utility	Mailed questionnaire, FPC Form 423	280 electric utilities	Plants with generating capacity of at least 25 megawatts	Mandatory
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Minor form modifications October 1974 January 1977	Manual audit and computer audit		Weighted averages of previous values.	Monthly	Since 1973	Five months for annual publication	Monthly data are also published. Prices are reported for No. 2 and No. 4 fuel oil.

PUBLICATION TITLE: Statistical Year Book of the Electric Utility Industry

ORGANIZATION: Edison Electric Institute

ADDRESS: 1140 Connecticut Ave., N.W., Washington, DC 20036

CONTACT: Thomas Daugherty PHONE NUMBER: (202) 828-7454

Data Description: Distillate							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	State	Average delivered prices \$/barrel ¢/10 ⁶ Btu	Utility	Monthly questionnaire	320 state operations of utilities	Utilities contributing to public supply 97% covered by EEI	Voluntary
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Crosschecking of monthly with annual data		None	Annual	About 20 years	10 to 13 months for annual data	Definition of "oil" includes fuel oil, crude oil, and small amounts of tar and gasoline.

PUBLICATION TITLE: Annual Survey of Manufacturers, Census of Manufacturers

ORGANIZATION: U.S. Department of Commerce, Bureau of the Census

ADDRESS: Washington, DC 20233

CONTACT: Dennis Wagner

PHONE NUMBER: (202) 763-5116

Data Description: Distillate								
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method		Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	State	Delivered, cost and quantity information given	Industrial	Form MA-100 mailed questionnaire		70,000 manufacturing companies	Probability sample including all firms with 250 or more employees and some smaller firms.	Mandatory
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments	
None	Computer and analytical checks for consistency with historic trends and current industry patterns.		None	Annual	1962, 1967, 1971, 1974-1978	Over 1 year	Distillate defined as No. 1, 2, 4 fuel oils, light diesel type fuel oil, and light gas enrichment oil. Industrial sector covers manufacturing industry.	

PUBLICATION TITLE: Platt's Oil Price Handbook and Oilmanac

ORGANIZATION: McGraw-Hill, Inc.

ADDRESS: 1221 Avenue of the Americas, New York, NY 10020

CONTACT: Joe Link

PHONE NUMBER: (202)624-7534

Data Description: Distillate							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method		Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	City	Monthly average of price highs and lows \$/gallon	No end-use sectors specified	Telephone survey		Undocumented	Voluntary
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Number of terminals reporting has increased over time	Check of anomalous data		None	Daily	53 years	Less than one year	Distillate prices may be any combination of No. 1 fuel/kerosene No. 2, or No. 4 fuel oil for any city

PUBLICATION TITLE: Gas Househeating Survey

ORGANIZATION: American Gas Association

ADDRESS: 1515 Wilson Blvd., Arlington, VA 22209

CONTACT: Larry Murphy PHONE NUMBER: (202) 841-8492

Data Description: Distillate							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	City	Average delivered price \$/10 ⁶ Btu	Residential	Mailed questionnaire	~200 utilities serving 84% of residential consumers	AGA members	Voluntary
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Data is compared with an expected range and suspect figures are checked.		Missing data is marked "NA"	Annual	1971 to present	Up to 9 months	Sample size varies yearly Data prior to 1971 may be available from AGA files. Distillate includes No. 1, 2 fuel oils, but not necessarily both for every city.

PUBLICATION TITLE: Consumer Prices: Energy

ORGANIZATION: Bureau of Labor Statistics

ADDRESS: Washington, DC 20212

CONTACT: Kay Ford

PHONE NUMBER: (202) 272-5177

Data Description: Distillate							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	SMSA	Volume-weighted average price including taxes \$/gallon	Residential	Dealer interviews by field agents	~450 dealers of No. 2 heating oil	Population weighted probability sample	Voluntary
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Sample size change in 1978	Staff check for inconsistencies		Marked "NA"	Monthly	Since 1978	3 weeks	Distillate includes No. 2 fuel oil 28 published cities cover 21 states 85 surveyed cities cover 41 states

PUBLICATION TITLE: Producer Prices and Price Indexes

ORGANIZATION: U.S. Department of Labor, Bureau of Labor Statistics

ADDRESS: Washington, DC 20212

CONTACT: Sarah Cohen PHONE NUMBER: (202) 272-5210

Data Description: Distillate							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Census Region	Average realized prices \$/gallon	No end-use sectors specified	Mailed questionnaire	28 refineries	Refiners are stratified by size	Voluntary
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Sample size increase in 1978	Revisions occur 4 months after original publication.		None	Monthly	Since 1975	One month	Prices are lagged one month. Data are not seasonally adjusted. Middle distillate is defined as fuel oil No. 2.

MOTOR GASOLINE

PUBLICATION TITLE: "Dealer and S.S. Price Averages: Gasoline," Platt's Oil Price Handbook and Oilmanac

ORGANIZATION: Lundberg Survey, Inc.^(a)

ADDRESS: P.O. Box 3996, North Hollywood, CA 91609

CONTACT: Trilby Lundberg PHONE NUMBER: (213) 768-5111

Data Description: Gasoline							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	City U.S.	Simple averaged pump price ¢/gallon	Transportation	Field survey	14,000 gasoline service stations	Randomly chosen from grids constructed in zip code areas	Voluntary
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Supervisors "over-drive" their reporters (about 10%)		None	Every two weeks	1955 to 1978	Two weeks	55 cities are reported covering the 48 continental states and the District of Columbia. Prices reported are for regular leaded gasoline for all types of service Collection resumed in 1981. (a) Lundberg Survey contracting to McGraw Hill, Inc, for publication in <u>Platt's</u>

PUBLICATION TITLE: "Platt's/Lundberg Summary," Platt's Oil Price Handbook and Oilmanac

ORGANIZATION: Lundberg Survey, Inc.

ADDRESS: P.O. Box 3996, North Hollywood, CA 91609

CONTACT: Trilby Lundberg PHONE NUMBER: (213) 768-5111

Data Description: Gasoline								
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method		Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	City U.S.	Volume-weighted average pump price ¢/gallon	Transportation	Field survey		14,000 gasoline service stations	Randomly chosen from grids constructed in zip code areas	Voluntary
Any Collection Method Change	Validation Procedure		Imputation of Missing Data		Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Supervisors "over drive" stringers (about 10%)		None		Every two weeks	1979 to 1980	One week	48 cities are reported covering 33 states and the District of Columbia. Prices reported by type and grade of gasoline and by type of service. Wholesale prices and margins are also included in the tables. Publication in <u>Platt's</u> discontinued in 1981.

PUBLICATION TITLE: Gasoline Prices

ORGANIZATION: Energy Information Administration

ADDRESS: Washington, D.C. 20461

CONTACT: Annie Whatley

PHONE NUMBER: (202) 252-6612

Data Description: Gasoline							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	U.S., Region State averages unpublished	Posted pump price on 15th day of reported month \$/gallon	Transportation	Mailed questionnaire, Form EIA-79	8000 retail gasoline service stations	Scientific probability sample	Mandatory
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Selective audits		None	Monthly	January 1978 through June 1980	3 months	Preceded by Form EIA-8 May-Dec. 1977 Prices and sales volumes reported by respondents by type and grade of gasoline, and by type of service

PUBLICATION TITLE: Consumer Price Index

ORGANIZATION: U.S. Department of Labor, Bureau of Labor Statistics

ADDRESS: Washington, DC 20212

CONTACT: Betty Rice

PHONE NUMBER: (202) 272-5080

Data Description: Gasoline							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	SMSA Census region	\$/gallon including taxes Price estimates are population weighted averages	Residential	BLS field agent contact with retailer	5 prices for each of 85 SMSAs	Retailers serving households in CPI survey	Voluntary
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Sample size increase in 1978 from 56 to 85 SMSA's and cities	Anomalous data are rechecked		Marked N.A. or previous data carried forward	Monthly	Since 1973	3 weeks	1973-77 sample covered 36 states 1978 sample covered 41 states Prices reported by type and grade of gasoline representing all types of service. Relative volumes of product type are unavailable.

PUBLICATION TITLE: Agricultural Prices

ORGANIZATION: U.S. Department of Agriculture, Crop Reporting Board

ADDRESS: Washington, D.C. 20250

CONTACT: Don Hulcher PHONE NUMBER: (202)447-4214

Data Description: Gasoline							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	State	Service station prices and bulk delivery retail prices \$/gallon including taxes	Transportation	Mailed questionnaire, Form OMB #40-R 1906	About 3000 gasoline dealers	Selected by each state office	Voluntary
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Anomalous data are checked		Substitution of regional averages for missing State data (common in New England states)	Monthly	30 years	2 weeks	Prices reported are service station unleaded regular and bulk delivery leaded regular

PUBLICATION TITLE: Producer Prices and Price Indexes

ORGANIZATION: U.S. Department of Labor, Bureau of Labor Statistics

ADDRESS: Washington, DC 20212

CONTACT: Sarah Cohen PHONE NUMBER: (202) 272-5210

Data Description: Gasoline							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Census Region	Average realized price of wholesalers to commercial consumers \$/gallon	Industrial Transportation	Mailed questionnaire	28 major refineries	Refineries stratified by size	Voluntary
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Sample size increased in 1978	Revisions occur four months after publication		None	Monthly	Since 1975	One month	Prices lagged one month in publication Prices are reported for regular leaded, regular unleaded, and premium leaded gasoline

PUBLICATION TITLE: Oil and Gas Journal

ORGANIZATION: Pennwell Publishing Co.

ADDRESS: 1421 S. Sheridan Road, Tulsa, Oklahoma 74101

CONTACT: Kathy Wilson PHONE NUMBER: 918-835-3161

Data Description: Gasoline							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	City	Estimated retail price ¢/gal. market share weighted	Transportation	Telephone survey	Number of reporting companies varies. Number of outlets represented is unknown.	Major brand companies	Voluntary
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
No	Comparison with prices published by DOE.		None	Weekly	Since 1970	One week	Wholesale price data is collected and used to estimate retail prices.

PUBLICATION TITLE: Oil Daily

ORGANIZATION: Oil Daily, Inc.

ADDRESS: 1230 Americana Bldg., Houston, TX 77002

CONTACT:

PHONE NUMBER: (713) 652-3870

Data Description: Gasoline							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	City	Dealer tank wagon and pump prices excluding taxes \$/gallon	Transportation	Undisclosed	Undisclosed	Undisclosed	Voluntary
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Undisclosed	Undisclosed		Undisclosed	Undisclosed	Undisclosed	One day	

DIESEL

PUBLICATION TITLE: Agricultural Prices

ORGANIZATION: U.S. Department of Agriculture, Crop Reporting Board

ADDRESS: Washington, D.C. 20250

CONTACT: Don Hulcher

PHONE NUMBER: (202) 447-4214

Data Description: No. 1-D and No. 2-D Diesel							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	State	\$/gallon retail price paid by farmers at mid-month	Industrial	Mailed survey with telephone followup Form OMB #40-R 1906	Approx. 3000 dealers	Selected at random by each USDA state office	Voluntary
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Change to probalistic sample in 1980	Check of anomalous data		New England's regional average is assigned to each state in region. Average of combined Delaware and Maryland data is assigned to each state.	Quarterly until 1977; monthly since 1978	30	6 months	Sales covered are both bulk delivery and service station

PUBLICATION TITLE: Quarterly No. 1-D Diesel Fuel Price Report

ORGANIZATION: American Public Transit Association

ADDRESS: 1225 Connecticut Avenue, Suite 200, Washington, D.C. 20036

CONTACT: John Neff

PHONE NUMBER: 202-828-2830

Data Description: No. 1 Diesel							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	DOE Regions	\$/gallon volume weighted average excluding taxes	Transportation	Mailed questionnaire	128 transit systems	300 association members	Voluntary
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	None		None	Quarterly	Since 1976	5 weeks	

PUBLICATION TITLE: Producer Prices and Price Indexes

ORGANIZATION: U.S. Department of Labor, Bureau of Labor Statistics

ADDRESS: Washington, D.C. 20212

CONTACT: Sara Cohen

PHONE NUMBER: (202) 272-5210

Data Description: Diesel							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Census Region	\$/gallon wholesale	Unspecified	Mailed questionnaire	28 refineries	Largest refineries	Voluntary
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Sample size increased in 1978	Revisions occur 4 months after original publication		None	Monthly	Since July 1975	One month	

PUBLICATION TITLE: Platt's Oil Price Handbook and Oilmanac

ORGANIZATION: McGraw-Hill, Inc.

ADDRESS: 1221 Avenue of the Americas, New York, NY 10020

CONTACT: Joe Link

PHONE NUMBER: (202)624-7534

Data Description: No. 1-D and No. 2-D Diesel

Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	City	\$/gallon Monthly weighted average of price highs and lows; Average annual price	Unspecified	Telephone	Varies by city depending on number of refiners, terminals or pipelines in areas.	Undocumented	Voluntary
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Number of terminals and ports has increased over time.	Check of anomalous data		None	Daily	53 years	Less than 10 months	

PUBLICATION TITLE: Prices and Margins of No. 2 Distillate Fuel Oil

ORGANIZATION: Energy Information Administration

ADDRESS: Washington, D.C. 20461

CONTACT: Annie Whatley

PHONE NUMBER: (202) 252-6612

Data Description: No. 2-D Diesel							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Company	Raw Data \$/gallon	Transportation Industrial	Mailed questionnaire EIA-9A	Approx. 3000 company-State units. (1800 individual companies)	Retailers/re-sellers of No. 2 distillate. Randomly chosen from stratified sample frame.	Mandatory
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Selective Audits. Minimum of five firms in each stratum; no one firm can have more than 40% of weight in that cell.		None	Monthly	Since November 1980	45 days	No. 2 diesel prices are combined with No. 2 fuel oil prices for publication diesel prices alone are unpublished.

KEROSENE and JET FUEL

PUBLICATION TITLE: Cost and Quality of Fuels for Electric Utility Plants

ORGANIZATION: Energy Information Administration

ADDRESS: Washington, D.C. 20461

CONTACT: Hugh Stewart PHONE NUMBER: (202) 275-4766

Data Description: Kerosene ^(a)							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	State	\$/BBL ¢/10 ⁶ Btu	Utility	Mailed questionnaire EPC Form 423	280 electric utilities	Plants with capacity greater than 25 MW using fossil fuels	Mandatory
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Form modification 10/74 and 1/77	Telephone check		Weighted averages of previous values	Annual monthly	Since 1973	5 months for annual edition	For combustion turbine and internal combustion units (a) Small amounts of jet fuel are included

PUBLICATION TITLE: Producer Prices and Price Indexes

ORGANIZATION: U.S. Department of Labor, Bureau of Labor Statistics

ADDRESS: Washington, D.C. 20212

CONTACT: Sarah Cohen

PHONE NUMBER: (202) 272-5210

Data Description: Kerosene and Jet Fuel							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Census region	\$/gallon	Unspecified	Mailed questionnaire	28 refineries	Largest refineries	Voluntary
Any Collection Method Change	Verification Procedure	Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments	
Sample size increased in 1978	Revisions occur 4 months after initial publication	None	Monthly	Since 1975	one month	Wholesale prices	

PUBLICATION TITLE: Agricultural Prices

ORGANIZATION: U.S. Department of Agriculture, Crop Reporting Board

ADDRESS: Washington, D.C. 20250

CONTACT: Don Hulcher PHONE NUMBER: (202)447-4214

Data Description: Kerosene							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	State	Prices paid by farmers	Industrial	Mailed questionnaire, Form OMB #40-R 1906, with telephone follow-up	About 3000 farmers	Selected by each state office	Mandatory
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Anomalous data are checked		Substitution of regional averages for missing state data (common in New England states)	Quarterly	1970-1976	2 weeks	

PUBLICATION TITLE: Platt's Oil Price Handbook and Oilmanac

ORGANIZATION: McGraw-Hill, Inc.

ADDRESS: 1221 Avenue of the Americas, New York, NY 10020

CONTACT: Joe Link

PHONE NUMBER: (202) 624-7534

Data Description: Kerosene							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Refineries and terminals	¢/gallon	Unspecified	Telephone	Varies by city depending on the number of refineries or terminals	Undocumented	Voluntary
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Number of terminals and refineries reporting has increased over time	Check of anomalous data		None	Daily	30 years		Annual average prices are not volume weighted The number of cities reporting kerosene prices has grown yearly since 1970

PUBLICATION TITLE: Monthly Petroleum Product Price Report

ORGANIZATION: Energy Information Administration

ADDRESS: Washington, D.C. 20212

CONTACT: Ron Stoner

PHONE NUMBER: (202) 252- 6577

Data Description: Kerosene and Jet Fuel							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	National	¢/gallon Volume weighted prices for each fuel	Unspecified	Mailed questionnaires EIA 9A, formerly EIA9 and FEA P112-M-1	Approx. 1600 dealers	Sample stratified by dealer type and size	Mandatory
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Sample size increase from 1100 to 1600 in 1980	Selective audit		None	Monthly	July 1975	45 days	

RESIDUAL FUEL OIL

PUBLICATION TITLE: Monthly Petroleum Product Price Report

ORGANIZATION: Energy Information Administration

ADDRESS: Washington, D.C. 20461

CONTACT: Gary Jane

PHONE NUMBER: (202) 252-6706

Data Description: Residual Fuel Oil							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Company; published at national level	Weighted average selling prices, wholesale and retail \$/barrel	No sectoral coverage	Monthly mailed questionnaire EIA-460 FEA-P302-M-1	~1120 resalers retailers and refiners	Refiners and re-salers/retailers who derive \$50 million or more annually from sales of products covered by EIA-460	Mandatory
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Selective Audits		Company contacted if fail to submit data. If data not available, mark "N/A"	Monthly	1975 to present	45 days	Fuel definition includes No. 5, No. 6, and Bunker C fuel oils. No. 6 prices given for 0.3%, 0.31% to 1%, and 1.01% and above sulfur levels.

PUBLICATION TITLE: Producer Prices and Price Indexes

ORGANIZATION: U.S. Department of Labor, Bureau of Labor Statistics

ADDRESS: Washington, D.C. 20212

CONTACT: Sarah Cohen PHONE NUMBER: (202) 272-5210

Data Description: Residual Fuel Oil							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Census region	Average realized wholesale prices \$/gallon	No end-use sectors specified	Mailed questionnaire	28 refineries	Refiners are stratified by size	Voluntary
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Sample size increase in 1978	Revisions occur 4 months after original publication		None	Monthly	Since 1975	One month	Prices are lagged one month. Data are not seasonally adjusted. Residual fuels are only No. 6 fuel oil and prices are by sulfur content categories: 0.3% or less, 0.31% to 1%, and more than 1%.

PUBLICATION TITLE: Platt's Oil Price Handbook and Oilmanac

ORGANIZATION: McGraw-Hill, Inc.

ADDRESS: 1221 Avenue of the Americas, New York, NY 10020

CONTACT: John Showstead PHONE NUMBER: (212) 997-3320

Data Description: Residual Fuel Oil							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	City	Monthly average of price highs and lows \$/gallon	No end-use sectors specified	Telephone survey	Varies by city, depending on the number of refineries, terminals or pipelines in area.	Undocumented	Voluntary
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Number of terminals reporting has increased over time	Check of anomalous data		None	Daily	53 years	Less than 10 months	Residual fuel products reported include No. 5 and No. 6 fuel oils, marine diesel, marine gasoil and Bunker C fuel.

PUBLICATION TITLE: Annual Survey of Manufacturers, Census of Manufacturers

ORGANIZATION: U.S. Department of Commerce, Bureau of the Census

ADDRESS: Washington, D.C. 20233

CONTACT: Dennis Wagner PHONE NUMBER: (202) 763-5116

Data Description: Residual Fuel Oil							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.s.	State	Delivered cost (\$) and quantity (000 barrels)	Industrial (Manufacturing)	Mailed questionnaire, MA-100	70,000 Manufacturing companies	Probability sample including all firms with 250 or more employees and some smaller firms	Mandatory
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Computer and analytical checks for consistency with historic trends and current industry patterns		None	Annual	1962, 1967, 1971, 1974-1978	Over one year	Residual fuel defined as No. 5 and No. 6 fuel oils; heavy diesel-type fuel oil; Bunker C fuel oils; and heavy gas-enrichment oil.

PUBLICATION TITLE: Cost and Quality of Fuels for Electric Utility Plants

ORGANIZATION: Energy Information Administration

ADDRESS: Washington, D.C. 20461

CONTACT: Kenneth McClerey PHONE NUMBER: (202) 252-5310
 Richard Salkov (202) 252-6522

Data Description: Residual Fuel Oil							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	State	Average delivered prices, ¢/10 ⁶ Btu \$/barrel Spot and contract prices	Utility	Mailed questionnaire FPC form 423	280 electric utilities	Plants with generating capacity of at least 25 megawatts	Mandatory
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Minor form modifications October 1974 January 1977	Manual audit and computer audit		Weighted averages of previous values	Monthly	Since 1973	Five months for annual publication	Monthly data are also published. Prices are reported for No. 5 and No. 6 by sulfur content

PUBLICATION TITLE: Statistical Year Book of the Electric Utility Industry

ORGANIZATION: Edison Electric Institute

ADDRESS: 1140 Connecticut Ave., NW, Washington, DC 20036

CONTACT: Thomas Daugherty PHONE NUMBER: (202) 828-7454

Data Description: Residual Fuel Oil							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	State	Average delivered prices \$/barrel ¢/10 ⁶ Btu	Utility	Monthly and annual statistical reports	320 state operations of utilities	Utilities contributing to public supply 97% covered by EEI	Voluntary
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Crosschecking of monthly with annual data		None	Annual	About 20 years	10 to 13 months for annual data	Definition of "oil" includes fuel oil, crude oil, and small amounts of tar and gasoline

LIQUEFIED PETROLEUM GAS

PUBLICATION TITLE: Gas Househeating Survey

ORGANIZATION: American Gas Association

ADDRESS: 1515 Wilson Blvd., Arlington, Virginia 22209

CONTACT: Larry Murphy

PHONE NUMBER: (202) 841-8492

Data Description: Propane							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Utility, city, census region	Average delivered price, excluding base load prices \$/million Btu	Residential	Mailed questionnaire	About 155 gas utilities	AGA members	Voluntary
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Data is compared with expected range and suspect figures are checked		Missing data are marked "NA"	Annual	1971 to present	Up to 9 months	Sample size varies yearly. Propane conversion factor used: 10.980 gallons/million Btu (1979) 10.917 gallons/million Btu (1971-1978)

PUBLICATION TITLE: Annual Survey of Manufactures, Census of Manufactures

ORGANIZATION: U.S. Department of Commerce, Bureau of the Census

ADDRESS: Washington, DC 20233

CONTACT: Dennis Wagner PHONE NUMBER: (202) 763-5116

Data Description: LPG							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	State	Delivered cost and quantity information given	Industrial	Form MA-100 mailed questionnaire	70,000 manufacturing companies	Probability sample including all firms with 250 or more employees and some smaller firms	Mandatory
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Computer and analytical checks for consistency with historic trends and current industry patterns		None	Annual	Since 1978	Over 1 year	Industrial sector covers only manufacturing industry Definition of LPG does not mention inclusion of ethane

PUBLICATION TITLE: Agricultural Prices

ORGANIZATION: U.S. Department of Agriculture, Crop Reporting Board

ADDRESS: Washington, D.C. 20250

CONTACT: Don Hulcher PHONE NUMBER: (202) 447-4214

Data Description: Liquefied Petroleum Gas							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	State	Average bulk delivery price on 15th day of month \$/gallon	Industrial	Mailed questionnaire with telephone follow-up Form OMB No. 40-R 1906	3000 farmers	Selected by each state office	Voluntary
Any Collection Method Change	Verification Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	Check anomalous data		None	Monthly	30 years	6 months for the annual summary	LPG not specifically defined on data collection form

PUBLICATION TITLE: Monthly Petroleum Product Price Report
 ORGANIZATION: Energy Information Administration
 ADDRESS: Washington, D.C. 20585
 CONTACT: Gary Jane PHONE NUMBER: (202) 252-6706

Data Description: Liquefied Petroleum Gas							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	Company, but published only at national level	Weighted monthly average selling price \$/gallon	No end-use sectors specified	Mailed questionnaire EIA-460, formerly FEA-P302-M-1	About 1120 dealers	Firms which derive \$50 million or more from annual sales of covered products	Mandatory
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Minor form change 9/80	Checks are made of suspect responses		Company contacted if data are missing. If data are not available then "NA" is used	Monthly	1975 to present	5 months for monthly petroleum product price report	

PUBLICATION TITLE: Platt's Oil Price Handbook and Oilmanac

ORGANIZATION: McGraw-Hill, Inc.

ADDRESS: 1221 Avenue of the Americas, New York, NY 10020

CONTACT: Ernie McClelland PHONE NUMBER: (212) 997-2937

Data Description: Liquefied Petroleum Gas							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	City	Truck transport, tank car, and pipeline input prices \$/gallon	No end use sectors specified	Telephone survey	Varies by city, depending on number of refineries, terminals, or pipelines	Undocumented	Voluntary
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
Number of terminals reporting increased in 1973.	Check anomalous data		None	Daily	53 years	Less than 10 months	LPG definition excludes ethane. Less than 12 cities reported each year

PUBLICATION TITLE: Butane Propane Newsletter

ORGANIZATION: Butane Propane News, Inc.

ADDRESS: 338 East Foothill Blvd., Arcadia, CA 91006

CONTACT: Bill Clark

PHONE NUMBER: (213) 357-2168

Data Description: Propane							
Geographic Scope	Level of Aggregation	Definition of Price/ Unit of Measurement	Sectoral Coverage	Data Collection Method	Sample Size	Sample Selection Criteria	Voluntary/ Mandatory Reporting
U.S.	City	Posted wholesale prices \$/gallon	No end use specified	Primarily telephone survey, with some forms	Undocumented	Major refiners and distributors	Voluntary
Any Collection Method Change	Validation Procedure		Imputation of Missing Data	Collection Frequency	Number of Years of Consistent Data	Lag to Publication	Comments
None	None		None	Weekly	Since 1975	one week	Approximately 30 states covered

APPENDIX F

TECHNIQUES OF REGRESSION ANALYSIS

APPENDIX F

REGRESSION ANALYSIS

Regression techniques are used in this report to impute for missing data. This appendix briefly reviews the meaning of regression statistics presented in the report, and explains the use of dummy variables in developing state-level models by pooling cross-sectional and time-series data. For a more complete explanation of regression techniques, a textbook on regression analysis or econometrics should be consulted.

A typical regression equation and some of its more important statistics are shown below in Equation F.1 which reproduces an earlier equation in Chapter 9 of this volume:

$$PJFUS_t = -3.1839 + 1.0404 \text{ PKSUS}_t \quad (F.1)$$

(-1.554) (21.862)

$$R_2 = 0.9876 \quad d.f. = 6 \quad D.W. = 3.120$$

Where:

$PJFUS_t$ = U.S. national average price of jet fuel in year t

$PKSUS_t$ = U.S. national average price of kerosene in year t

The equation relates U. S. average prices of jet fuel to the corresponding U. S. prices of kerosene. In addition to the estimated values of the intercept and slope terms, the above expression also provides the calculated values of the t statistic, the degrees of freedom, the coefficients of determination, and the Durbin-Watson (D.W.) statistic. Each of these are explained briefly below.

Degrees of Freedom (d.f.)

Degrees of freedom is a measure of the number of independent pieces of information in a regression model. The degrees of freedom is equal to the sample size (number of observations), less the number of coefficients to be estimated. In the equation above, there were eight observations and two coefficients to be estimated (the intercept and slope parameters). The model thus has six degrees of freedom.

t-Statistic

The t-statistic is commonly printed in parenthesis beneath estimated coefficients in a regression equation. The t-statistics allows testing of the significance of these parameter estimates. The larger the absolute value of t, the greater the probability that the corresponding parameter estimate is statistically significant. The critical values of the t statistic vary according to the degrees of freedom and the level of significance, and are usually determined by consulting a t-Table. As a general rule, if a t-value exceeds 2 in absolute value, it can be assumed that the dependent variable is significantly related to the explanatory or independent variables in the statistical sense.

The t-values in Equation F.1 indicate that the intercept term is not significantly different from zero. It also shows that the national jet fuel price is strongly related to the national prices of kerosene.

Durbin-Watson Statistic (D.W.)

The Durbin-Watson statistic provides a test for the statistical significance of first order autocorrelation in a time-series regression model. Autocorrelation occurs when the differences between actual and estimated values of the dependent variable, known as residuals, are correlated with each other in a time-series regression model. First-order autocorrelation occurs when sequential pairs of residuals are correlated.

The Durbin-Watson statistic varies in magnitude from 0 to 4. Values close to 2 imply no first order autocorrelation; values close to 0 imply positive autocorrelation, and values close to 4 imply negative autocorrelation. Many of the regression models in this report used pooled cross-sectional and time-series data. As a result, the Durbin-Watson statistic loses its precision in determining autocorrelation. In such cases, the statistic is presented only for the sake of completeness.

In Equation F.1, the Durbin-Watson statistic is fairly high, indicating that negative first order auto-correlation may exist in the model.

Coefficient of Determination (R^2)

The coefficient of determination, or R-square as it is usually known, measures the fraction of variance in the dependent variable that can be accounted for by the estimated equation. Values of the R^2 statistic range in value from 0 to 1. Values close to 0 imply the model explains little of the variations in the dependent variable, while values close to 1 indicate that the model could account for most of the dependent variable's variation. The R^2 value in Equation F.1 indicates that the regression model can explain over 98% of the variation in the price of jet fuel.

Dummy Variables

Dummy variables are used in regression models to isolate non-quantitative factors. The regression models in this report use dummy variables to isolate unspecified factors in states and regions which offset fuel prices. In some cases, the year in which an observation was made can also be taken into account by the dummy variable. A dummy variable is set equal to 1 when the condition to be isolated is present. In all other cases it is equal to 0. With pooled state-level data, the single equation estimated from the data can, in effect, represent different equations for different states, depending on the actual state dummies included.

Equation F.2 reproduces Equation 9.2 in Volume 2, Chapter 9 of this report:

$$PXX_t = 0.4588 + 1.0122 PUTUS_t + \sum_{XX=1}^{51} d_{XX} \cdot DSXX + \sum_{XX=1}^{51} g_{XX} \cdot (DSXX \cdot PUTUS_t) \quad (F.2)$$

(0.828) (17.605)

$$R^2 = 0.9663 \quad d.f. = 185 \quad D.W. = 2.593$$

Where:

PXX_t = residual fuel prices in state XX

$PUTUS_t$ = national average utility sector residual fuel price.

Note that the estimates of d_{XX} and g_{XX} , and their corresponding t-statistics are shown in Table 9.5. For the following discussion, the reader will need to refer back to this table.

Equation F.2 relates state level residual fuel prices as a function of average U. S. utility sector prices and some unspecified state correction factors as represented in the differences in the estimated intercept and slope terms. This equation is expressed in general form, allowing for variations in both the intercept and slope terms. If the composite variable, $(DSXX \cdot PUTUS_t)$ were dropped, then only the intercept term would be different across states while the slope term will be fixed at 1.0122. If the DSXX term were dropped, then only the slope term will be allowed to vary, the intercept term would be held constant at 0.4588.

Since Massachusetts was the reference state, the equation can be reduced to the following expression for Massachusetts by assigning the value of zero to all DSXX's in Equation F.2:

$$PMA_t = 0.4588 + 1.0122 \text{ PUTUS}_t \quad (F.3)$$

For California, the fifth state in the data file, the value of zero is assigned to all DSXX's except for $XX = CA$ in which case the value of 1.0 is assigned to Equation F.2. As a result, the following is obtained:

$$\begin{aligned} P_{CA,t} &= (0.4588 + 0.3203) + (1.0122 - 0.2144) \text{ PUTUS}_t \\ &= 0.7791 + 0.7978 \text{ PUTUS}_t \end{aligned} \quad (F.4)$$

The values of the second term within each paranthesis on the right hand side of the equation are from Table 9.5.

Equations for other states can be derived in a similar manner. Note, however, that although the above discussion on the intermediate steps is useful for interpretational purpose, Equation F.2 can be applied directly to impute the necessary state prices without going through the intermediate steps.

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