

Appendix A

Technical Notes

Technical Note 1: EIA-821: Annual Fuel Oil and Kerosene Sales Report, 2007

Background

The EIA-821, “Annual Fuel Oil and Kerosene Sales Report” survey was implemented to meet Energy Information Administration (EIA) legislative mandates and data user needs. Form EIA-821 is used to gather data on the sales to energy users of distillate fuel oil, residual fuel oil, and kerosene. The data are used to determine the level of demand by energy use category and product at the State, regional, and national levels. This mandatory report is authorized by the Federal Energy Administration Act of 1974 (P. L. 93-275).

The predecessor survey to the EIA-821 was the EIA-172, “Sales Report of Fuel Oil and Kerosene” survey. The EIA-172 was conducted for reference years 1979 through 1982. Due to a serious deterioration in the sample of respondents during the 4-year period, the Form EIA-172 data were not collected for 1983. Instead, estimates for 1983 were published and a new sample of respondents was designed and selected from an improved sampling frame. The EIA-821 survey commenced with reference year 1984.

Discussion of Sampling Frame

The target population for the fuel oil and kerosene sales survey is the universe of companies that sell fuel oil and kerosene to energy users.

The EIA-863 database provided the sampling frame for the EIA-821 survey. The EIA-863, “Petroleum Product Sales Identification Survey,” was mailed to approximately 25,000 companies in January 2003 to collect 2002 State-level sales volume data for No. 2 distillate, residual fuel, motor gasoline, and propane. Companies also indicated if they sold kerosene. The No. 2 distillate data were further identified by residential and nonresidential energy use, and non-energy use sales; the residual data were identified by energy use and non-energy use; motor gasoline was identified by energy use and non-energy use and by conventional and oxygenated and/or reformulated; and propane was identified by residential, nonresidential, and non-energy use sales. The mailing list for the EIA-863 survey was constructed by merging and unduplicating the 1998 frame file and more than 50 State and commercial lists. In addition, company/State-level volumes for distillate fuel,

residual fuel, motor gasoline, and propane from the 2002 EIA-821 survey were merged with the EIA-863 to yield a combined data file. The transformed and edited version of the frame was then used to design and select the 2007 EIA-821 sample.

It should be noted that truck stops selling No. 2 diesel fuel were not specifically included in the EIA-863 survey. Therefore, the EIA-821 survey does not include all sales of No. 2 distillate through retail truck stops. However, to compensate for this shortage in coverage, data from the Federal Highway Administration are presented in the tables for on-highway diesel sales.

The sampling frame also lacked full coverage of kerosene retailers, many of whom are hardware stores and service stations. To account for all kerosene volumes supplied to the marketplace, aggregate reported kerosene volumes are set equal to the products supplied volumes published in the *Petroleum Supply Annual*.

Discussion of the Sample Design

The purpose of the EIA-821 sample design was to produce State-level estimates of total sales for the following five target variables: (1) residential No. 2 distillate, (2) other retail No. 2 distillate, (3) wholesale No. 2 distillate, (4) retail residual, and (5) wholesale residual. A separate sample was initially designed for each target variable.

Companies were divided into two basic types of strata: certainty and noncertainty. Companies selected with certainty were:

- All refiners and gas plant operators.
- Companies doing business in four or more States.
- Companies accounting for 5 percent or more of the distillate or residual fuel oil volume for any target variable or particular energy use category sold in a State.
- Companies accounting for 5 percent or more of the kerosene volume sold in a State in an earlier EIA-821 survey.
- Augmented frame units, e.g., vessel bunkering, for which no attribute data were available.

Firms determined not to be selling distillate or residual fuel oil or kerosene were removed from the frame file. Volumes for nonrespondents to the EIA-863 who had reported in the previous frame survey or in a sample survey were imputed. The imputed

nonrespondents and the noncertainty companies were stratified by sales volume for each target variable. Strata boundaries were determined using the Dalenius-Hodges procedures, allowing the number of strata and the strata boundaries to vary by State. Nonrespondents for whom no previous information was available were classified in a separate stratum and sampled with reduced probabilities of selection.

Neyman allocation was used to allocate the number of companies required for each strata to obtain the required levels of accuracy: a 2.5 percent coefficient of variation for residual fuel oil and a 5 percent coefficient of variation for distillate fuel oil. Sample selections were then performed simultaneously from the same random list for the five samples to produce a final linked sample of approximately 4,000 companies. This method reduced the total survey sample size while improving volume estimates. Selected companies were asked to report sales by end-use categories for distillate and residual fuel oil and kerosene.

Imputation and Estimation

Survey data gathered from the respondents may contain incomplete reporting, total nonresponse, or values that fail editing. Missing data are estimated, or implicitly imputed for, using the strata means and treated the same as reported data. The weighted estimate is defined as follows:

$$\hat{V} = \sum_h N_h \left(\sum_i W_{hi} V_{hi} / \sum_i W_{hi} \right)$$

where:

\hat{V} = total estimated volume

\sum_h = denotes summation over strata

N_h = stratum population for stratum h

\sum_i = denotes summation over units within stratum h

V_{hi} = volume reported for unit i in stratum h

W_{hi} = weight attached to unit i in stratum h

where: W_{hi} is inversely proportional to the probability of inclusion in the linked sample.

The degree of imputation by product and energy use at the U.S. total level ranged as follows for the 2007 EIA-821 data: distillate, 2.95 percent for railroad use to 15.91 percent for commercial use; residual fuel oil, 0.11 percent for oil company use to 10.20 percent for

commercial use; and kerosene, 2.76 percent for industrial use to 9.43 percent for all other uses.

Collection Methods

The EIA-821 form was mailed in January 2008 to all companies selected for participation in the 2007 reference year survey. The completed form was due to EIA on March 7, 2008. A second request was mailed to nonrespondents approximately 1 month after the filing deadline. Follow-up telephone calls were made to collect outstanding data and to verify reported data. Late submissions and resubmissions were processed when received.

Data Processing

As EIA-821 forms were received, they were logged into an automated Survey Control File that maintains company identification and survey form status information for each company selected to participate in the survey. The data were reviewed manually, entered onto the computer files, and then processed through an automated edit program, which detected missing data and outlying values. Data that failed the edits were resolved through telephone calls to the data reporters and corrections were entered onto the computer files. Preliminary estimates were generated and processed through a series of validation procedures to flag and rectify potential misreporting of data. Statistical reports, including publication tables, were produced using only acceptable and verified data.

Technical Note 2: Reliability of the Data

Two types of errors are associated with data produced from a sample survey; sampling errors and nonsampling errors. Sampling errors occur because the estimates are based on a sample rather than on a census. The particular sample used for the EIA-821 survey is one of a large number of samples of equal size which could have been selected from the sampling frame using the same sample design. Each of these samples would produce a different estimate. If the estimates were averaged over all possible samples, the result would be the same as the estimate derived from a census of the sampling frame. The sampling error is a measure of variability among the estimates from all possible samples and, thus, is a measure of the precision with which an estimate from a particular sample approximates the results of a census.

Nonsampling errors and biases can arise from a number of sources: (1) inability to obtain information about all cases in the sample, (2) response errors, (3) differences in the interpretation of questions or definitions, (4) mistakes in recording or coding of the data obtained, and (5) other errors of collection, response, coverage, and estimation for missing data. Bias is the difference between the average of the estimates over all possible samples of the same size and design, and the true value being estimated. It is not possible to estimate bias using the results of one sample.

Data obtained from alternate sources are not subject to sampling errors, but may be subject to nonsampling errors, the magnitudes of which are unknown. Nonsampling errors for survey estimates and estimates adjusted to alternate sources cannot be determined, but attempts are made throughout survey processing to minimize this type of error.

Data in Tables 1 through 12 are based on survey data that are subject to sampling errors. Coefficients of variation, which are estimates of sampling errors, are presented for the retail target variables in the following table for the 2007 survey. The coefficients of variation (CV) were estimated by:

$$CV(\hat{V}) = \frac{\sqrt{VAR(\hat{V})}}{\hat{V}}$$

where:

$$VAR(\hat{V}) = \sum_h n_h \left(1 - \frac{n_h}{N_h}\right) S_h^2$$

$$S_h^2 = \frac{\sum_{i=1}^{n_h} W_i^2 V_i^2 + \bar{V}_h^2 \sum_{i=1}^{n_h} W_i^2 - 2\bar{V}_h \sum_{i=1}^{n_h} W_i^2 V_i}{n_h - 1}$$

$$\bar{V}_h = \frac{\sum_{i=1}^{n_h} W_i V_i}{\sum_{i=1}^{n_h} W_i}$$

\hat{V} = total estimated volume

N_h = stratum population for stratum h

n_h = number of sample units in stratum h

V_i = volume for unit i

W_i = weight for unit i

Response rates also offer some indication of the reliability and comprehensiveness of survey results. For the 2007 EIA-821 survey, the overall response rate (the number of submissions received, divided by the number of submissions solicited and expected, times 100) was 87.3 percent.

Technical Note 3: Data Adjustments

Alternate Source Data

After all preliminary tabulations were verified, comparisons were made between the survey results and available alternate source data. The following energy use categories were replaced by alternate source data at the U.S., Petroleum Administration for Defense (PAD) district, or State level:

Tables 1 through 12:

On-Highway Diesel. Distillate fuel oil by State was calculated from the Federal Highway Administration data on highway use of special fuels. Of the 2003 through 2007 special fuels, more than 99 percent is diesel.

Tables 13 through 24:

The 2006 adjusted numbers have been revised since they were first published in the Fuel Oil and Kerosene Sales 2006. The revisions to the data were made to include new distillate and residual volumes for "Electric Power". When we originally published the Fuel Oil and Kerosene Sales 2006, the "Electric Power" information was still being collected and verified. See Electric Power below for further explanation on how the data are calculated.

Electric Power. National-level distillate and residual fuel oil sales for electric power use were calculated from annual aggregations of data collected on the EIA-906, "Power Plant Report." Form EIA-906 utility and non-utility, NAICS 22 companies, consumption data was added to the stock change of distillate and residual, respectively. Allocations at the State level were based on the EIA-821 survey.

Coefficients of Variation for Sales of Fuel Oil, 2007

Geographic Area	Residential Distillate Fuel Oil	Non-Residential Retail Distillate Fuel Oil	Retail Residual Fuel Oil
U.S. Average	2.0	1.0	0.1
PAD District 1 Average	2.2	1.1	0.1
Subdistrict 1A Average	2.6	2.2	0.0
Connecticut	6.1	3.9	0.0
Maine	3.5	5.7	0.0
Massachusetts	5.0	4.7	0.0
New Hampshire	3.7	4.3	0.0
Rhode Island	5.9	2.7	0.0
Vermont	2.6	4.2	0.0
Subdistrict 1B Average	3.5	1.8	0.1
Delaware	6.0	3.4	0.0
District of Columbia	0.0	0.0	0.0
Maryland	6.1	1.7	0.0
New Jersey	7.3	3.2	0.0
New York	5.3	3.7	0.1
Pennsylvania	7.0	3.5	0.0
Subdistrict 1C Average	4.9	1.7	0.3
Florida	11.4	4.5	0.0
Georgia	12.0	2.8	2.9
North Carolina	7.9	3.5	0.0
South Carolina	12.5	3.5	0.0
Virginia	6.9	4.2	0.0
West Virginia	7.2	5.7	0.0
PAD District 2 Average	3.0	1.3	0.3
Illinois	10.7	5.5	5.4
Indiana	14.2	4.0	2.8
Iowa	12.0	5.0	0.1
Kansas	20.8	5.8	0.0
Kentucky	4.7	4.7	0.0
Michigan	6.3	5.8	0.4
Minnesota	7.9	5.6	0.0
Missouri	4.0	3.4	0.0
Nebraska	17.7	5.4	0.0
North Dakota	11.0	5.4	0.0
Ohio	8.1	4.6	0.0
Oklahoma	0.0	4.8	0.0
South Dakota	11.7	2.6	0.0
Tennessee	12.4	3.3	3.7
Wisconsin	5.2	3.3	0.0
PAD District 3 Average	3.8	3.4	0.0
Alabama	1.4	4.5	0.0
Arkansas	3.4	10.5	0.0
Louisiana	2.8	4.0	0.0
Mississippi	0.0	2.3	0.0
New Mexico	21.3	2.7	0.0
Texas	24.3	5.8	0.0
PAD District 4 Average	18.0	2.4	0.0
Colorado	23.3	4.8	0.0
Idaho	5.6	3.9	0.0
Montana	46.1	6.3	0.0
Utah	0.1	5.9	0.0
Wyoming	4.6	5.0	0.0
PAD District 5 Average	2.1	2.9	0.0
Alaska	1.9	0.2	0.0
Arizona	0.0	2.9	0.0
California	9.4	4.1	0.0
Hawaii	120.2	0.0	0.0
Nevada	0.0	4.8	0.0
Oregon	8.8	5.1	0.0
Washington	3.9	13.1	0.0

Note: Coefficients of variation that are less than 0.1 and greater than zero are displayed as 0.1.

Sources: • Energy Information Administration Form EIA-821, "Annual Fuel Oil and Kerosene Sales Report," for 2007.

On-Highway Diesel. Distillate fuel oil by State was calculated from the Federal Highway Administration data on highway use of special fuels. Of the 2003 through 2007 special fuels, more than 99 percent is diesel.

2003 through 2007 Adjustments

Kerosene volumes in Tables 1 through 24 are adjusted at the national level to equal products supplied volumes as published in the “Detailed Statistics” section of the Petroleum Supply Annual (PSA). The 2007 survey resulted in 376,411 thousand gallons of kerosene at the national level. The products supplied volume at the national level for kerosene was 492.702 thousand gallons. Hence, the adjustment factor at the national level for 2007 was 1.31.

Volumes of distillate fuel oil in Tables 13 through 24 were adjusted at the PAD district level to equal products supplied volumes. The adjustment factors at the PAD district level for 2007 are as follows:

Distillate Fuel Oil

PAD District 1:	.97
PAD District 2:	1.10
PAD District 3:	1.36
PAD District 4:	.70
PAD District 5:	.98

For Tables 13 through 24, total sales at the PAD district level equal the products supplied volumes as reported in the PSA, 2003 through 2007. For example, the 2007 survey yielded a volume for distillate residential use in PAD District 2 of 392,590 thousand gallons. The total distillate volume for PAD District 2 was 5,835,539 from the survey, after subtracting the volume coming from alternate sources. The product supplied total distillate volume for PAD District 2 was 6,422,059 after removing alternate source volume. Hence, the adjusted 2007 estimate of distillate for residential use in PAD District 2 was $(6,422,059/5,835,539) \times 392,590 = 432,049$. For distillate fuel oil in Tables 13 through 24, the PAD district adjustments were made to each State and product-use category except on-highway diesel and electric power uses.

Volumes of residual fuel oil in Tables 13 through 24 were adjusted at the national level to equal the products supplied estimate. The 2007 survey yielded 10,706,479 gallons of residual fuel oil, while the products supplied volume at the national level was

11,082,162 thousand gallons. Thus, the adjustment factor at the national level for 2007 was 1.07, after subtracting the volumes coming from alternate sources. For residual fuel oil, the adjustments were made to each State and energy use category except electric power.

Technical Note 4: Energy Use Descriptions and Petroleum Product Definitions

Energy Use Descriptions

Residential. An energy-consuming sector that consists of living quarters for private households. Common uses of energy associated with this sector include space heating, water heating, air conditioning, lighting, refrigeration, cooking, and running a variety of other appliances. Sales to farmhouses are reported under “Farm” and sales to apartment buildings are reported under “Commercial.”

Commercial. An energy-consuming sector that consists of service-providing facilities and equipment of nonmanufacturing businesses; Federal, State, and local governments; and other private and public organizations, such as religious, social, or fraternal groups. The commercial sector includes institutional living quarters. Common uses of energy associated with this sector include space heating, water heating, air conditioning, lighting, refrigeration, cooking and running a wide variety of other equipment.

Industrial. An energy-consuming sector that consists of all facilities and equipment used for producing, processing, or assembling goods. The industrial sector encompasses the following types of activity: manufacturing and mining. Overall energy use in this sector is largely for process heat and cooling and powering machinery, with lesser amounts used for facility heating, air conditioning, and lighting. Fossil fuels are also used as raw material inputs to manufactured products.

Oil Company. An energy-consuming sector that consists of drilling companies, pipelines or other related oil companies not engaged in the selling of petroleum products. Includes fuel oil that was purchased or produced and used by company facilities for operation of drilling equipment, other field or refinery operations, and space heating at petroleum refineries, pipeline companies, and oil-drilling companies. Sales to other oil companies for

field use are included, but sales for use as refinery charging stocks are excluded.

Farm. An energy-consuming sector that consists of establishments where the primary activity is growing crops and/or raising animals. Energy use by all facilities and equipment at these establishments is included, whether or not it is directly associated with growing crops and/or raising animals. Common types of energy-using equipment include tractors, irrigation pumps, crop dryers, smudge pots, and milking machines. Facility energy use encompasses all structures at the establishment, including the farm house.

Electric Power. An energy-consuming sector that consists of electricity only and combined heat and power (CHP) plants whose primary business is to sell electricity, or electricity and heat, to the public--i.e., NAICS 22 plants. Volumes directly imported and used by the electric power companies are included.

Railroad. An energy-consuming sector that consists of all railroads for any use, including that used for heating buildings operated by railroads.

Vessel Bunkering. An energy-consuming sector that consists of commercial or private boats such as pleasure craft, fishing boats, tugboats, and ocean-going vessels, including vessels operated by oil companies. Excluded are volumes sold to the U. S. Armed Forces.

On-Highway Diesel. An energy-consuming sector that consists of motor vehicles: automobiles, trucks, and buses. Vehicles used in the marketing and distribution of petroleum products are also included.

Military. An energy-consuming sector that consists of the U.S. Armed Forces, Defense Energy Support Center (DESC), and all branches of the Department of Defense (DOD).

Off-Highway. An energy-consuming sector that consist of:

1. **Construction.** An energy-consuming sub sector that consist of all facilities and equipment including earthmoving equipment, cranes, generators, air compressors, etc.
2. **Other.** An energy-consuming sub sector that consists of all off-highway uses other than construction. Includes logging, scrape and junk yards, and refrigeration units on trucks.

All Other Uses. Sales for all other energy-consuming sectors not included elsewhere.

Definitions of Petroleum Products and Other Related Terms

ASTM. The acronym for the American Society for Testing and Materials.

Distillate Fuel Oil. A general classification for one of the petroleum fractions produced in conventional distillation operations. It includes diesel fuels and fuel oils. Products known as No. 1, No. 2, and No. 4 diesel fuel are used in on-highway diesel engines, such as those in trucks and automobiles, as well as off-highway engines, such as those in railroad locomotives and agricultural machinery. Products known as No. 1, No. 2, and No. 4 fuel oils are used primarily for space heating and electric power generation.

1. **No. 1 Distillate.** A light petroleum distillate that can be used as either a diesel fuel or a fuel oil.
 - a. **No. 1 Diesel Fuel.** A light distillate fuel oil that has distillation temperatures of 550 degrees Fahrenheit at the 90-percent point and meets the specifications defined in ASTM specification D 975. It is used in high-speed diesel engines generally operated under frequent speed and load changes, such as those in city buses and similar vehicles.
 - b. **No. 1 Fuel Oil.** A light distillate fuel oil that has distillation temperatures of 400 degrees Fahrenheit at the 10-percent recovery point and 550 degrees Fahrenheit at the 90-percent point and meets the specifications defined in ASTM Specification D 396. It is used primarily as fuel for portable outdoor stoves and portable outdoor heaters.
2. **No. 2 Distillate.** A petroleum distillate that can be used as either a diesel fuel or a fuel oil.
 - a. **No. 2 Diesel Fuel.** A fuel that has distillation temperatures of 400 degrees Fahrenheit at the 10-percent recovery point and 640 degrees Fahrenheit at the 90-percent recovery point and meets the specifications defined in ASTM Specification D 975. It is used in high speed diesel engines that are generally operated under uniform speed and load conditions such as those in railroads locomotives, trucks, and automobiles.

- (1) **Ultra Low Sulfur No. 2 Diesel Fuel.** No. 2 diesel fuel that has a sulfur level no higher than 15 ppm by weight. It is used primarily in motor vehicle diesel engines for on-highway use.
- (2) **Low Sulfur No. 2 Diesel Fuel.** No. 2 diesel fuel that has a sulfur level no higher than 500 ppm by weight. It is used primarily in motor vehicle diesel engines for on-highway use.
- (3) **High Sulfur No. 2 Diesel Fuel.** No. 2 diesel fuel that has a sulfur level above 500 ppm by weight.

b. **No. 2 Fuel Oil (Heating Oil).** A distillate fuel oil that has distillation temperatures of 400 degrees Fahrenheit at the 10-percent recovery point and 640 degrees Fahrenheit at the 90-percent recovery point and meets the specification defined in ASTM specification D 396. It is used in atomizing type burners for domestic heating or for moderate capacity commercial/industrial burner units.

3. **No. 4 Fuel.** A distillate fuel oil made by blending distillate fuel oil and residual fuel oil stocks. It conforms with ASTM Specification D 396 or Federal Specification VV-F-815C and is used extensively in industrial plants and in commercial burner installations that are not equipped with preheating facilities. It also includes No. 4 diesel fuel used for low-and medium-speed diesel engines and conforms to ASTM Specification D 975.

NOTE: Respondents to the EIA-821 survey were instructed to report all volumes in accordance with what the product was sold as, regardless of the actual specifications of that product. For example, if a No. 2 distillate was sold as a heating oil or fuel oil, the volume would be reported in the category "No. 2 Fuel Oil" even if the product conformed to the higher specifications of a diesel fuel.

Kerosene. A light petroleum distillate that is used in space heater, cook stoves, an water heaters and is suitable for use as a light source when burned in wick-fed lamps. Kerosene has a maximum distillation temperature of 400 degrees Fahrenheit at the 10-percent recovery point, a final boiling point of 572 degrees Fahrenheit, and a minimum flash point of 100 degrees Fahrenheit. Included are No. 1-k and No. 2-k, the two grades of kerosene called range or stove oil, which have properties similar to those of No. 1 fuel oil.

PAD District. Petroleum Administration for Defense Districts.

PAD District 1 (East Coast):

Subdistrict 1A (New England):

Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.

Subdistrict 1B (Central Atlantic):

Delaware, District of Columbia, Maryland, New Jersey, New York, and Pennsylvania

Subdistrict 1C (Lower Atlantic):

Florida, Georgia, North Carolina, South Carolina, Virginia, and West Virginia

PAD District 2 (Midwest):

Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, Ohio, Oklahoma, Tennessee, and Wisconsin

PAD District 3 (Gulf Coast):

Alabama, Arkansas, Louisiana, Mississippi, New Mexico, and Texas

PAD District 4 (Rocky Mountains):

Colorado, Idaho, Montana, Utah, and Wyoming

PAD District 5 (West Coast):

Alaska, Arizona, California, Hawaii, Nevada, Oregon, and Washington

Residual Fuel Oils. A general classification for the heavier oils, know as No. 5 and No. 6 fuel oils that remain after the distillate fuel oils an lighter hydrocarbons are distilled away in refinery operations. It conforms to ASTM Specification D 396 and D 975 and Federal Specification VV-F-815C. No. 5, a residual fuel oil of medium viscosity, is also know as Navy Special and is defined in Military Specification MIL-F859E, including Amendment 2 (NATO Symbol F-77). It is used in steam-powered vessels in government service and inshore power plants. No. 6 fuel oil includes Bunker C fuel oil and is used for the production of electric power, space heating, vessel bunkering, and various industrial purposes.

United States. The United States includes the 50 states and the District of Columbia.