



Independent Statistics & Analysis

U.S. Energy Information
Administration

Supporting Statement for Survey Clearance of U.S. Energy Information Administration's (EIA) Oil and Gas Reserves System Surveys

Part B: Collections of Information Employing Statistical Methods

*Form EIA-23L, Annual Report of Domestic Oil and Gas Reserves
Extension of Collection with changes*

*Form EIA-23S, Annual Report of Domestic Oil and Gas Reserves
Continuation of suspension*

*Form EIA-64A, Annual Report of the Origin of Natural Gas Liquids Production
Extension of Collection without change*

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B.1. Respondent Universe

Form EIA-23L

The Form EIA-23L, Annual Survey of Domestic Oil and Gas Reserves, collects data on domestic production and reserves of crude oil, condensate, and natural gas. Each respondent reports proved reserves and production for crude oil and lease condensate, and natural gas, by state/state subdivision in which it operates, as well as the reservoir type associated with the reserves. Respondents will report the total reserves and the shale component in Parts 4 and 5 respectively.

Operators of crude oil and natural gas wells were selected as the appropriate respondent population for Form EIA-23L because the well operators have access to the most current and detailed reserves information. Therefore, they presumably have better proved reserves estimates than other possible classes of respondents, such as working interest or royalty owners.

The universe of currently active oil and natural gas well operators in the United States contains roughly 15,000 operators. Though the very large operating companies (e.g. ExxonMobil Corporation, ConocoPhillips, Chevron, BP, Shell Oil Corporation) are well-known to EIA, they comprise only a small portion of all U.S. operators. The 200 largest operators produce more than 85% of the nation's oil and natural gas. The small volume well operators are difficult to identify because they go into and out of business more easily, frequently alter their corporate identities, make relatively large property sales and acquisitions that significantly change their size, and often change addresses. EIA uses commercial vendors of production data (e.g. IHS Markit, Enverus DrillingInfo), and operator data from state regulatory agencies, to build and maintain its survey frames. The frame is updated each year. Information on mergers, acquisitions, and property transfers is obtained from industry newsletters, commercial data vendors, and the EIA-914 survey.

Form EIA-64A

Form EIA-64A, complementary to the EIA-23L, collects data on production of natural gas liquids. The EIA-64A is a census of natural gas processing plants. All natural gas processing plant operators need to file Form EIA-64A for each plant that they own. Natural gas processing plants report natural gas liquids production by the area of origin of the natural gas processed.

The survey frame contains contact information and production data on all known active and inactive natural gas processing plants in the United States (currently less than 600). Operators of plants that closed or ceased operations during the reporting year are required to complete forms for that portion of the reporting year the plants were operated.

Operators of natural gas plants were selected because they have access to the most current and detailed information on natural gas plant liquids. These operators have more complete information on gas plant liquids production, gas inlet, and dry gas outlet data than gas producers or pipeline companies.

B.2. Statistical Methods

Sampling

Current Form EIA-23L

EIA uses a non-probabilistic cutoff sample design that consists of the well operators with the largest crude oil or natural gas production in each regional breakout. The sample is reselected each year. The sample design focuses on the largest oil and gas production operators in the nation, and then in a state/state subdivision¹ to generate summary-level data. Operators are added to the sample until a production coverage percentage is reached for the nation (85%), then in each state/state subdivision (50%). Operators with more than 10% gas or oil production in a state/state subdivision are also included in the sample. Operators with less than 600,000 MCF of nationwide natural gas production annually (1.64 MMCF per day) and less than 500 barrels of oil per day nationally are excluded from the frame.

Estimates are required for multiple attributes (natural gas and liquids by state/state subdivision and by reservoir type). Thus, a variant of cutoff sampling, quasi-cutoff sampling, allows a sample design that yields reliable estimates for the various attributes (sometimes called “target variables,” or “variables of interest”)². Because many operators selected for their production in one attribute (e.g., liquids) will also have production in other attributes (e.g., gas), a few more respondents may be added to the sample than the minimum number required to meet the coverage threshold for a particular attribute in a particular state/state subdivision. This may cause some state/state subdivisions to appear to have a few “extra” respondents scattered throughout the population, but the total number of respondents does not increase.

The cutoff sample for the Form EIA-23L consists of approximately 500 respondents. Sampling is based on annual production volumes of the well operators, at the national level and the state/state subdivision level. State/state subdivisions and reservoir types define the estimation groups, see **Estimating Proved Reserves** section below. Using this sample design, EIA expects approximately 90% of U.S. oil and natural gas reserves volumes will be reported on the Form EIA-23L, leaving the remaining 10% to be estimated.

The cutoff sample for the Form EIA-23L is selected based on coverage thresholds set at national and state/state subdivision levels for each product (oil and gas) and reservoir type. The sample design provides high coverage for each publication and estimation group (state/state subdivision by reservoir type) except for groups that lack eligible operators whose production is higher than the minimum requirements mentioned above. Groups without enough eligible operators may not achieve the coverage targets without sampling a large number of extremely small operators. In some situations, data for some areas will be combined or withheld to prevent disclosure issues.

See **Efforts to Reduce Total Survey Error** section for estimates of anticipated RSEs.

Estimating Proved Reserves

¹ The term “state/state subdivision” refers to an individual subdivision within a state or an individual state that is not subdivided.

² Knaub J.R., Jr. (2011). “Cutoff Sampling and Total Survey Error,” *Journal of Official Statistics*, Letter to the Editor, 27(1), pp. 135-138. <http://www.jos.nu/Articles/abstract.asp?article=271135>

The published estimates of U.S. proved reserves and production are the sum of the estimates for the individual states covered by the sample. Correspondingly, estimates for the states with subdivisions (estimates are published separately by subdivision for California, Federal Offshore, Louisiana, New Mexico, and Texas) are the sum of the subdivision estimates. The remaining states are not subdivided and may be considered as a single subdivision. This cutoff sample will result in collecting approximately 90% of the U.S. proved reserves for both oil and gas being reported directly on Form EIA-23L, and leaves the remaining 10% to be estimated.

Production data from other sources (Commercial vendors or the state regulatory agencies) are used to estimate proved reserves for the non-surveyed operators. The estimates are based on reported reserves and production at the operator/state or state subdivision level.

The published reserves estimates are created using a linear regression model relating production to proved reserves. The equation is fit separately for each state/state subdivision, and each fuel type (crude oil and natural gas). Additional estimates would be created for shale natural gas and oil from tight formations, using appropriate subtotals of state/state subdivision level data. Some state/state subdivisions are combined because they have too few operators for sufficient statistical rigor when analyzed individually.

Use of this estimation procedure reduces reporting and analysis burden by minimizing the number of operators that have to be surveyed.

Operators that report very high reserves-to-production ratios are excluded from the calculation of the state/state subdivision coefficients, since EIA does not expect them to be representative of smaller operators. (Note that the aforementioned situation is rare—the reported values of this type are typically erroneous or based on less than a full year’s production.)

The linear regression model is used to estimate reserves of non-sampled operators that are listed in the frame file with positive production values in all states, except Illinois, Indiana, Kentucky, and Tennessee. Only oil production is available for Illinois and Indiana. Kentucky data lag by two years, and Tennessee data are not available after 2016. The same estimation procedure described above is not applicable in these states.

Obtaining operator production data for the smaller oil and gas producing states of Illinois, Indiana, Kentucky, and Tennessee requires an alternative approach from using commercial or state agency data when the data is not current. Samples of operators in these states are compiled from lists of oil and gas companies licensed to do business in the state, internet searches, and past reports on Forms EIA-23L. When production data is not current or not available, the sampling process described in the previous section cannot be used. The summary-level data (U.S. level and “Other States” level) may be published including these states ‘as reported’ (i.e., no estimates for the total state population will be generated for these states).

The largest operators in the states of Illinois, Indiana, Kentucky, and Tennessee are identifiable using prior years’ data, and from state regulatory agencies where current data are available. However, the frame will be incomplete and may be insufficient to reliably estimate reserves for non-sampled operators in these states. These four states, when combined, are estimated to hold less than 0.2% of U.S. total oil and condensate reserves and less than 0.4% of U.S. total natural gas reserves.

EIA will continue to study the available frame information for Illinois, Indiana, Kentucky, and Tennessee to determine if reliable proved reserve estimates can be generated using the same methods as in the other states. In particular, EIA will coordinate with state agencies, including agencies other than oil and gas regulatory agencies, and industry trade journals, newsletters, etc., to build a sample frame that includes these states.

Estimating Reserves Balancing Categories

Estimated proved reserves categories (i.e., sales, acquisitions, extensions and discoveries, etc.) are assumed to have the same relationship to estimated year-end reserves as the reported proved reserves categories have to the reported year-end reserves. Ratios for the total reported categories in a state/state subdivision are applied to the estimated reserves volumes to calculate the estimated categories. Estimated category items will have the same proportion to year-end reserves as do the reported volumes.

The following reserve categories are reported on Form EIA-23L:

Sales (amount of reserves transferred if operations were sold to another company)

Acquisitions (amount of reserves acquired if operators or properties were purchased or transferred)

Extensions and Discoveries (Extensions are reserves additions that result from expanding the proved acreage of previously discovered reserves through additional drilling. Discoveries are the sum of new field discoveries, and new reservoir discoveries found during a survey year)

Report Year Production (the volumes produced from wells in the state/state subdivision)

Total Producing Proved Reserves at End of Report Year

Total Non-Producing Proved Reserves at End of Report Year.

Some reasons why proved reserves may not “add up” from one year to the next include:

- The inclusion of operators with the same operating characteristics in each year’s sample is uncertain. There is no guarantee in the smaller producing states/subdivisions that the same small operators will be selected each reporting year, or that the operators selected will have similar production volumes when compared with operators selected in a prior reporting year.
- Operators may make revisions to their prior year’s proved reserves because of technical challenges or advancements, production performance, or economic reasons.
- The frame sample coverage may or may not have improved between survey years, such that more or fewer operators were included in the reporting year than the previous year.
- One or more operators may have reported data incorrectly in one reporting year or the next, but not both, and the error was not detected during data validation.
- Operation of properties was transferred during the reporting year from operators not in the sample to surveyed operators.
- Operation of properties was transferred during the reporting year to an operator with a different evaluation of the proved reserves associated with the properties than that of the previous year’s operator.
- The trend in reserves changes imputed for the non-sampled operators, which was based on the trend reported by the sampled operators, did not reflect the actual trend for the non-sampled operators.

The only problems for which the effects cannot be expected to balance over a period of several years are problems associated with an inadequate survey frame or with any actual trend in reserves changes for non-sampled operators not being the same as the reserves changes for sampled operators. EIA continues to attempt to improve sources of operator data to create as comprehensive a frame as possible.

Yield of Natural Gas Plant Liquids and Dry Natural Gas from Total Natural Gas

The published reserves, production, and reserves change statistics for crude oil and lease condensate, and natural gas (wet after lease separation) are derived from data reported on Form EIA-23L and the application of the estimation methods discussed previously. The information collected on Form EIA-64A is then utilized to calculate, on a regional basis, the estimated yield of natural gas plant liquids and dry natural gas from total natural gas (wet after lease separation).

In estimating the volumes of dry natural gas, downward adjustments of the natural gas data, wet after lease separation, are made. These reductions are based on estimates of the gaseous equivalents of the liquids removed (in the case of production), or expected to be removed (in the case of reserves), from the natural gas stream at natural gas processing plants. Form EIA-64A collects the natural gas liquids used to calculate shrinkage of the input natural gas stream that results from the removal of the natural gas plant liquids (NGPL) at each natural gas processing plant.

The shrinkage volume is then applied to the plant's reported area or areas of origin. The shrinkage is in proportion to the reported production of NGPL volumes for each area of origin. However, these derived shrinkage volumes are rejected if the ratio between the shrinkage and the NGPL production (gas equivalents ratio) fall outside certain limits of physical accuracy. The ratio is expected to range between 1,558 cubic feet per barrel (for ethane) and 811 cubic feet per barrel (where NGPL consists primarily of plant condensate). When the computed gas equivalents ratio falls outside these limits, an imputed ratio is utilized to estimate the plant's natural gas shrinkage allocation to each reported area of origin.

This imputed ratio is calculated for the aggregate of all other plants from the area that are reporting NGPL production and also have a gas equivalent ratio within the aforesaid limits. The imputed ratio is applied only if there were at least five plants reporting NGPL production in a producing area that are within these range limits. If there are less than five plants, the imputed ratio is calculated based on all plants in the survey for which the individual gas equivalents ratio is within the acceptable limits. Less than 1% of gas liquids production is associated with shrinkage volumes imputed in this manner. Based on the Form EIA-64A survey of 2020, the national weighted average gas equivalents ratio was computed to be 1,421 cubic feet of natural gas shrinkage per barrel of NGPL recovered.

The total shrinkage volume (reported plus imputed) for all plants reporting a given area of origin is then subtracted from the estimated value of natural gas production (wet after lease separation) yielding dry natural gas production for the area. The amount of the reduction in the wet natural gas production is then expressed as a percentage of the wet natural gas production. The expected yield of dry natural gas can then be calculated from wet natural gas proved reserves and proved reserves changes by using the same percentage reduction factor.

Imputation for Item Non-Response

Form EIA-23L

Survey questionnaire items for which a response is not received are anticipated to be rare for the sampling method for Form EIA-23L. Non-response items will be imputed, using the linear regression model in the same manner as for the non-sampled cases.

Form EIA-64A

Form EIA-64A uses a census frame file to collect data from all active natural gas processing plants. NGPL recovery rates are calculated from data supplied on Form EIA-64A. If a plant fails to report data, EIA will follow up with the plant operator to acquire the missing data. In the very rare event the data is lost or unattainable, production data from the Form EIA-816, Monthly Natural Gas Plant Liquids Report, is used to calculate an estimated shrinkage factor for that plant, but this would not provide the area of origin data needed for the natural gas liquids production.

Frame Maintenance

Form EIA-23L

Since its inception in 1977, EIA has maintained an oil and natural gas operator sampling frame of the nation's producers. EIA uses various sources of information to maintain the completeness of the frame, including trade press, other data providers, and state regulatory agencies. EIA plans to maintain the natural gas, crude oil, and lease condensate frame by continuing similar practices.

EIA continuously reviews all available information to adjust the survey frame for the Form EIA-23L data collection for births, deaths, mergers, and company information changes.

Form EIA-64A

Each year, the Form EIA-64A plant frame is compared to listings of natural gas processing plants from the Form EIA-816, Monthly Natural Gas Plant Liquids Report, the LPG Almanac, and the Oil and Gas Journal. A list of possible changes to the plant frame is compiled each year. Telephone calls to the newly-identified plants are conducted to verify their operating status. Changes identified during frame maintenance are coordinated with the Form EIA-816 program office at EIA.

Efforts to Reduce Total Survey Error

Frame Coverage Errors

Of all the sources of controllable error connected with the Form EIA-23L survey, errors in identifying the survey frame are expected to have the greatest impact on estimates. If the sampling frame does not list all well operators in a given state (referred to as undercoverage), it could lead to either misidentification of the largest operators selected for the sample or underestimation of the non-sampled operators.

Undercoverage does not appear to have been a problem with respect to the total U.S. domestic proved reserves estimates for either crude oil or natural gas, but it may occur within individual state/state subdivisions. EIA uses a state/state subdivision cutoff in addition to a U.S. total cutoff so the potential to miss a significant operator within a state is reduced—lessening or preventing undercoverage.

While it is relatively straightforward to use existing sources to identify large operators and find addresses for them, such is not the case for small operators. The Form EIA-23L frame is most likely to be deficient in states where a large portion of total proved reserves and production is accounted for by a multitude of different, smaller operators (e.g., individuals who operate one or two “stripper” wells). These states are not likely to allocate sufficient resources to keep track of all operators on a current basis. Some undercoverage of this type may exist, particularly with respect to natural gas well operators. EIA is continuing to work to remedy the undercoverage problem in those states where this problem has occurred.

Reporting Errors and Data Processing Errors

Reporting errors on the part of respondents are of concern in a survey of the magnitude and complexity of the Form EIA-23L. Several steps have been taken by EIA to minimize and detect such problems. The survey instrument is carefully developed, and includes a detailed set of instructions for filing data, subject to a common set of definitions similar to those already used by the industry. EIA uses software encoded with a set of edits to validate the data and detect different kinds of probable reporting errors and flag them for resolution by analysts, either through confirmation of the data by the respondent or through submission of amendments to the filed data. Data processing errors, consisting primarily of random keypunch errors, are detected by the same software.

Estimation Errors by Respondents

The principal data elements of the Form EIA-23L survey consist of respondent estimates of proved reserves of crude oil and lease condensate, and natural gas. However, until a particular reservoir has been fully produced to its economic limit and abandoned, the proved reserves of the reservoir are not subject to direct measurement, but instead must be inferred from limited, imperfect, or indirect evidence. As a result, respondents cannot perfectly estimate their proved reserves, and such estimates change over time.

Reserves estimates change from year to year as new discoveries are made, as existing fields are more thoroughly appraised, as existing reserves are produced, and as prices and technologies change. Higher fuel prices typically increase proved reserves estimates (positive revisions) as operators consider a broader portion of the resource base economically producible, or proved. Lower prices, on the other hand, generally reduce estimates (negative revisions) as the economically producible base diminishes.

Sampling Errors

As in most establishment surveys, Form EIA-23L reserves and production data are highly skewed. In most states, reserves data for natural gas, and oil and lease condensate are provided by relatively few larger well operators, and there are many small operators.

Relative Standard Errors are published based on the linear regression model that was used to estimate reserves for nonsampled operators.

Unit Non-response

Non-response is anticipated to be minimal for the Form EIA-23L sampling method. Because estimated reserves are published at aggregated levels by state/state subdivision, these rare non-responses are not anticipated to have a significant impact on published totals. For the 2020 data collection cycle, Form EIA-23L survey response rate was 90% (372 of 412).

For the EIA-64A 2020 data collection cycle, Form EIA-64A survey response rate was 97% (519 of 536).

B.3. Maximizing Response Rates

EIA uses standard procedures to conduct the data collections for the Form EIA-23L and Form EIA-64A. An introductory letter signed by a relevant EIA official is sent to each company that is selected for the sample. Follow-up procedures for non-response consist of an email message or a reminder letter (for those not using email) to all companies that do not return a completed survey form by the due date. This reminder communication is followed by repeated email messages, letters, and phone calls until a response is received or other agreeable solution is found.

B.4. Test Procedures and Form Consultations

Changes are proposed for the Form EIA-23L, but not the Form EIA-64A data collections, and Form EIA-23S is unchanged and currently suspended. Therefore, cognitive testing was performed on the revised EIA-23L form to determine continued usefulness and new burden estimates only for Form EIA-23L.

B.5. Statistical Consultations

For additional information concerning this data collection, please contact Steven Grape at (202) 586-1868, or steven.grape@eia.gov.