Supporting Statement for Oil and Gas Reserves System Surveys

August 2025

Part B: Collections of Information Employing Statistical Methods
OMB No. 1905-0057

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

Form EIA-23S, Annual Survey 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 with changes

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Table of Contents

B.1. Respondent Universe....2
B.1.1. Form EIA-23L....2
B.1.2. Form EIA-64A....2
B.2. Statistical Methods....3
B.2.1. Sampling....3
B.2.1.1. Form EIA-23L....3
B.2.1.2. Form EIA-64A....4
B2.2. Estimation....4
B.2.2.1. Proved Reserves....4
B.2.2.2. Reserves Balancing Categories....5
B.2.2.3. Yield of Natural Gas Plant Liquids and Dry Natural Gas from Total Natural Gas....6
B.2.2.4. Imputation for Item Non-Response....7
B.2.2.4.1. Form EIA-23L....7
B.2.2.4.2. Form EIA-64A....7
B.2.3. Frame Maintenance....7
B.2.3.1. Form EIA-23L....7
B.2.3.1. Form EIA-64A....8
B.2.4. Efforts to Reduce Total Survey Error....8
B.2.4.1. Frame Coverage Errors....8
B.2.4.2. Reporting Errors and Data Processing Errors....8
B.2.4.3. Estimation Errors by Respondents....8
B.2.4.4. Sampling Errors....9
B.3. Maximizing Response Rates....9
B.4. Test Procedures and Form Consultations....9
B.5. Statistical Consultations....10

B.1. Respondent Universe

Survey	Approximate Population Size	Approximate Sample Size
Form EIA-23L	15,000	420
Form EIA-64A	458	458

B.1.1. Form EIA-23L

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. Operators report the subtotal of proved reserves from shale plays on Section 5 of Form EIA-23L.

The respondent population for Form EIA-23L is the population of operators of crude oil and natural gas wells. Well operators have access to the most current and detailed reserves information, providing them with 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 divestitures and acquisitions that significantly change their size, and often change addresses. The private company Enervus sells a well-level data set of monthly production created by amalgamating data obtained from state agencies. EIA uses the Enervus dataset as the primary source for defining the population for the EIA-23L. This data is further supplemented with state agency data for certain states that are not present in the data. From this dataset the EIA-23L sample is selected. Industry newsletters, commercial data vendors, and the EIA-914, Monthly Crude Oil and Lease Condensate, and Natural Gas Production Report, provide information on mergers, acquisitions, and property transfers.

B.1.2. Form EIA-64A

Form EIA-64A, *Annual Report of the Origin of Natural Gas Liquids Production*, 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 must file a 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 500). 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.

The appropriate respondent population for Form EIA-64A is the operators of natural gas plants 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

B.2.1. Sampling

B.2.1.1. Form EIA-23L

EIA uses a non-probabilistic cutoff sample design that consists of well operators with the largest crude oil or natural gas production in the nation and/or 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 each state/state subdivision[1]. Operators are added to the sample until a production coverage percentage of 90% is reached for the nation, then in each state/state subdivision until 60% state/state subdivision coverage is reached. Operators with more than 10% gas or oil production in a state/state subdivision are also included in the sample. 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 Form EIA-23L consists of approximately 420 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

[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. https://www.researchgate.net/publication/261757962_JOS_Letter_-_Cutoff_Sampling_and_Total_Survey_Error

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 many extremely small operators

See *Efforts to Reduce Total Survey Error* section for estimates of anticipated relative standard errors.

B.2.1.2. Form EIA-64A

Form EIA-64A is a census of natural gas processing plants. EIA does not perform any sampling for this survey.

B2.2. Estimation

B.2.2.1. Proved Reserves (EIA-23L)

Proved producing reserves (the operator extracted resources from the reserves during the last year) are estimated using the method described below. Published proved non-producing reserves (the operator did not extract resources from wells during the last year) are the sum of reported data and are not estimated for unsampled companies. In recent EIA reserves reports, proved nonproducing reserves accounted for about a third of total proved reserves. Total proved reserves are the sum of proved producing reserves and proved nonproducing reserves.

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.

The published proved reserves are estimated by using a linear regression model relating production to proved producing reserves. The regression model is fit separately for each state/state subdivision and each fuel type (crude oil and natural gas) and reservoir type (shale/conventional). Additional estimates are created for shale natural gas and oil from tight formations, using appropriate subtotals of state/state subdivision level data. Some state/state subdivisions may be combined if 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 must be surveyed.

Operators that report very high reserves-to-production ratios are excluded from estimation of the regression coefficients, since EIA does not expect them to be representative of smaller operators. (Note that the 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 in the sampling frame 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. For those states, published proved producing reserves are the sum of reported proved producing reserves.

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. EIA uses lists of oil and gas companies licensed to do business in the state, internet searches, and past reports on Forms EIA-23L to compile samples of operators in these states. 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 sampling 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 sampling 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. EIA will coordinate with state agencies, including agencies other than oil and gas regulatory agencies, and industry trade journals, newsletters, etc., to build a sampling frame that includes these states.

B.2.2.2. Reserves Balancing Categories

Estimated proved reserves categories (i.e., divestitures, acquisitions, extensions and discoveries, etc.) are assumed to be proportional to total end of year proved reserves plus production. The estimate for a particular proved reserves category 'X' is given by

$$X_{Unsampled} = \left(Production_{Unsampled} + Reserves_{Unsampled}\right) \frac{X_{Sampled}}{\left(Production_{Sampled} + Reserves_{Sampled}\right)}$$

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:

- Divestitures (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.

Prior year's reserves, minus divestitures, plus acquisitions, plus extensions and discoveries, minus production over the previous year, should approximate the current year's reserves. However, 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 sample selection will include the same small operators 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 revise 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, including more or fewer operators in the reporting year than in the previous year.
- One or more operators may have reported data incorrectly in one reporting year or the next, but not both, and data validation did not detect the error.
- Operators not in the sample transferred the operation of properties to surveyed operators during the reporting year.
- The previous year's operator transferred the operation of properties during the reporting year to an operator with a different evaluation of the proved reserves associated with the properties.
- 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.

B.2.2.3. Yield of Natural Gas Plant Liquids and Dry Natural Gas from Total Natural Gas

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

First, since some gas may bypass processing plants and be sold directly, EIA calculates for the ratio of total wet gas production in state ‘s’ to gas sent through a processing plant. The production data is from the EIA-23L frame data, and the inlet gas comes from the EIA-64A data having an area of origin as state ‘s’.

$$PlantRatio_s = \frac{PlantInputs_s}{WetGasProduction_s}$$

Where

$PlantInputs_s$ is the total inlet gas from the EIA-64A having an area of origin as state ‘s’.

$WetGasProduction_s$ is the total natural gas production in state ‘s’ listed in the EIA-23L frame.

Second, EIA calculates a state level shrinkage factor based on data from the EIA-64A as

$$Shrinkage_s = \frac{DryGasOutput_s}{PlantInputs_s}$$

Where

$DryGasOutput_s$ is the total outlet gas in state ‘s’ after processing

Then dry gas reserves can then be calculated as

$$DryGasReserves_s = WetGasReserves_s * PlantRatio_s * Shrinkage_s + WetGasReserves_s * \left(1 - PlantRatio_s\right)$$

Where

$WetGasReserves_s$ is the total wet gas reserves in state ‘s’ as estimated by the EIA-23L.

And NGL reserves can be calculated as

$$NGLReserves_s = NGLProduction_s \frac{WetGasReserves_s}{WetGasProduction_s}$$

Where

$NGLProduction_s$ is the total liquids production from gas having an area of origin as state ‘s’ from the EIA-64A.

In Alaska, large amounts of natural gas processed makes the above methodology invalid. Instead, a plant ratio of 1 is assumed and the shrinkage factor is calculated based on gas processed in select plants.

B.2.2.4. Imputation for Item Non-Response

B.2.2.4.1. Form EIA-23L

EIA anticipates that survey questionnaire items for which a response is not received will be rare for the Form EIA-23L sampling method. EIA will impute non-response items using the same linear regression model that is used to produce estimates for the non-sampled cases.

B.2.2.4.2. Form EIA-64A

EIA uses a census to collect data from all active natural gas processing plants for Form EIA-64A and calculates NGPL recovery rates from the data supplied. If a plant fails to report data, EIA will follow up with the plant operator to acquire the missing data. In the very rare case that 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.

B.2.3. Frame Maintenance

B.2.3.1. 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 Enverus and various sources of information to maintain the completeness of the sampling frame, including trade press, other data providers, and state regulatory agencies.

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.

The smaller oil and gas producing states of Illinois, Indiana, Kentucky, and Tennessee do not have current operator level production data and require an alternative approach. EIA uses lists of oil and gas companies licensed to do business in the state, internet searches, and past reports on Forms EIA-23L to compile samples of operators in these states. 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). 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.

B.2.3.1. Form EIA-64A

Each year, EIA compares Form EIA-64A plant frame to listings of natural gas processing plants from the Form EIA-816, Monthly Natural Gas Plant Liquids Report, the Liquified Petroleum Gas (LPG) Almanac, and the Oil and Gas Journal and compiles a list of possible changes to the plant frame. EIA contacts the newly identified plants to verify their operating status and coordinates any changes identified during sampling frame maintenance with EIA's Form EIA-816 program office.

B.2.4. Efforts to Reduce Total Survey Error

B.2.4.1. Frame Coverage Errors

Of all the sources of controllable error connected with the Form EIA-23L survey, EIA expects errors in identifying the survey frame to have the greatest impact on estimates. If the sampling frame does not

list all well operators in a state (referred to as under-coverage), it could lead to either misidentification of the largest operators selected for the sample or underestimation of the non-sampled operators.

Under-coverage does not appear to have been a problem regarding the total U.S. domestic proved reserves estimates for either crude oil or natural gas, but it may occur within individual state/state subdivisions.

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 sampling frame for Form EIA-23L is most likely to be deficient in states where a multitude of different, smaller operators (e.g., individuals who operate one or two "stripper" wells) account for a large portion of total proved reserves and production. These states are not likely to allocate sufficient resources to keep track of all operators currently. Some under-coverage of this type may exist, particularly regarding natural gas well operators.

B.2.4.2. Reporting Errors and Data Processing Errors

Reporting errors by respondents are of concern in a survey of the magnitude and complexity of the Forms EIA-64A and EIA-23L. EIA has taken several steps to minimize and detect such problems. The survey instrument includes a detailed set of instructions for filing data, subject to a common set of definitions like those already used by the industry. EIA uses software encoded with a set of edits to validate the data and detect different 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. The same software detects data processing errors, consisting primarily of random keypunch errors. EIA analysts review the data to ensure data consistency, and especially that property transfers are reported and correctly accounted for in estimates.

B.2.4.3. 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 an operator fully produces a particular reservoir to its economic limit and abandons it, the proved reserves of the reservoir are not subject to direct measurement. Respondents must infer the proved reserves from limited, imperfect, or indirect evidence. As a result, respondents cannot perfectly estimate their proved reserves, and such estimates change over time.

Operators change reserves estimates from year to year based on new discoveries, more thorough appraisal of existing fields, production of existing reserves, and changes in prices and technologies. 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.

B.2.4.4. Sampling Errors

As in most establishment surveys, Form EIA-23L reserves and production data are highly skewed. In most states, with relatively few larger-well operators providing the majority of reserves data for natural gas and oil and lease condensate, and there are many small operators accounting for a relatively small percentage of reserves data.

B.3. Maximizing Response Rates

EIA uses standard procedures to conduct the data collections for Form EIA-23L and Form EIA-64A. EIA sends an introductory letter signed by a relevant EIA official 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. Repeated email messages, letters, and phone calls follow this reminder communication until EIA receives a response is received or finds another agreeable solution.

For the 2024 data collection cycle, the preliminary Form EIA-23L survey response rate was 92.9% (369 of 397). The preliminary Form EIA-64A survey response rate was 98.7% (451 of 457).

B.4. Test Procedures and Form Consultations

EIA performed cognitive testing for the Form EIA-64A to evaluate the addition of two questions from the suspended Form EIA-757A (part of EIA's Natural Gas data collection package OMB No. 1905-0175) regarding total capacity and average heat content, the addition of a new question about ethane content, and associated burden changes. EIA also performed sensitivity testing for Form EIA-64A to evaluate potential disclosure of data at a plant-level instead of an aggregated state-level. However, given current resource constraints, EIA is not proposing any changes in the data collections at this time.

The cognitive testing performed on Form EIA-64A respondents revealed some uncertainty about the current instructions and definitions. EIA is proposing minor instruction clarifications for both Forms EIA-23L and EIA-64A.

B.5. Statistical Consultations

For additional information concerning this data collection, please contact Kenneth Pick, EIA Clearance Officer, at (202) 586-5562, or kenneth.pick@eia.gov.