

This is a working document prepared by the Energy Information Administration (EIA) in order to solicit advice and comment on statistical matter from the American Statistical Association Committee on Energy Statistics. This topic will be discussed at EIA's spring 2006, meeting with the Committee to be held April 6 and 7, 2006.

# The Energy Information Administration's Monthly Natural Gas Production Survey and Proposed Crude Oil Production Survey

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## Part 1. Abstract

This paper documents the development of the Form EIA-914<sup>1,2</sup>, “The Monthly Natural Gas Production Survey”. It will also set the stage for a discussion of the proposed survey revision to the EIA-914, which, if approved, would collect crude oil production data, as well as natural gas production data. Provided is a quick summary of the frame, a description of the data, and a portrayal of the cut-off sample which is currently used for the EIA-914. A variation of this cut-off sample will be similarly employed for the proposed crude oil production addition to the survey. A brief summary of the estimation procedure based on the EIA-914 cut-off sample will also be shared, where again the estimation procedure for the proposed crude oil survey would be similar in methodology.

## Part 2. Background

The Energy Information Administration (EIA) publishes estimates monthly and annually of the production of natural gas and crude oil in the United States. Estimated natural gas production is published by state and for the Federal Gulf of Mexico. Estimated crude oil production is published by geographically orientated pads. Through the end of 2004, the estimates for both natural gas and crude oil have been based on data EIA collected from oil and gas producing states and data collected by the U. S. Minerals Management Service (MMS) in the Department of Interior. State agencies and MMS collect this information from producers of natural gas or crude oil for various reasons, most often for revenue purposes. However, reporting on the form EIA-895, Quantity and Value of Natural Gas Production, and separate reporting of crude oil production by State agencies and the MMS is neither complete nor timely.

Hence, EIA began to address these problems by first examining natural gas production. EIA had developed estimation methodologies used in conjunction with the EIA-895 data and other available information to generate monthly production estimates for publication in EIA’s *Natural Gas Monthly (NGM)* about 120 days after the close of the reference month. EIA data have shown that natural gas production has remained relatively flat. However, during 2003 and 2004 there was debate in the media, stating that natural gas production had started to decline. While EIA did not believe that the media sources were accurate, we also did not have total confidence in the timeliness or accuracy of our monthly data.

The EIA-914 is a monthly survey that was designed to fill this data need. Data are collected by and reported for the six largest gas-producing areas (Texas, the Federal Gulf of Mexico, New Mexico, Louisiana, Oklahoma, and Wyoming) and the U.S. Total. Half of the gas produced in the United States comes from the Federal Gulf of Mexico and

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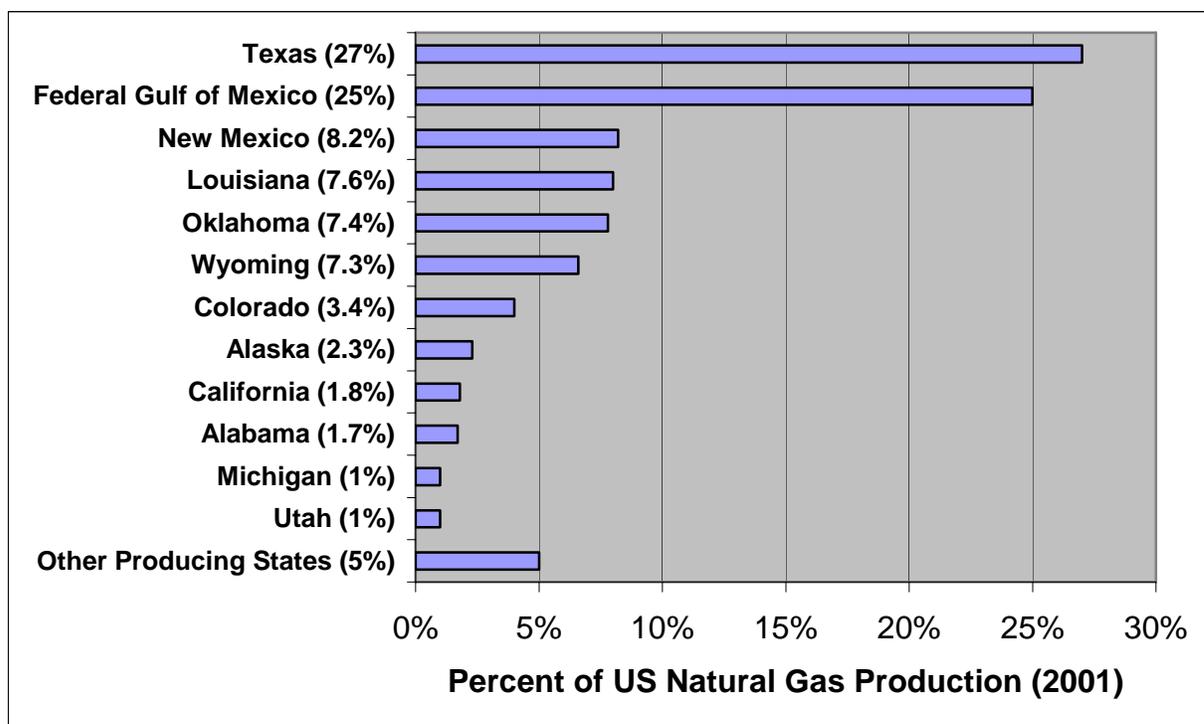
<sup>1</sup> Form EIA-914: [http://www.eia.doe.gov/pub/oil\\_gas/natural\\_gas/survey\\_forms/eia914i.pdf](http://www.eia.doe.gov/pub/oil_gas/natural_gas/survey_forms/eia914i.pdf)

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Texas (Figure 1). Data are eventually expected to be available for publication 60 days after the close of the reference month, in other words, in half the time currently required to publish estimates.

The Statistics and Methods Group (SMG) worked with the Office of Oil and Gas (OOG) in the development of a new survey, Form EIA-914, to collect timely natural gas production information. SMG conducted cognitive tests to support the creation of an understandable survey instrument and collaborated with OOG on an investigation to demonstrate the instrument's usability. SMG prepared the Office of Management and Budget (OMB) forms clearance package and developed responses to comments from the public.

**Figure 1. Major Natural Gas Producing States (2001)**



SMG used simulations<sup>3</sup> to evaluate two methods of selecting a sample and also evaluated a number of different estimation methods. These studies lead EIA to select a cut-off sample (initially designed to cover 90% of production) because it would provide the greatest accuracy of the data with the least amount of burden on the respondents. The Reserves and Production Division (RPD) of EIA developed the estimation methods, as well as the imputation methods for nonresponse. The survey instrument and sampling plan were approved by OMB in September 2004. In October of 2004, at EIA's American Statistical Association (ASA) Committee on Energy Statistics, the EIA-914 sample

<sup>3</sup> Simulation Study: [http://www.eia.doe.gov/smg/asa\\_meeting\\_2004/fall/files/paper.doc](http://www.eia.doe.gov/smg/asa_meeting_2004/fall/files/paper.doc)

design and estimation methodology were discussed. The first series of data was collected for the month of January 2005.

### **Part 3. Cut-Off Sample**

Initially, SMG evaluated a probability proportional to size sample using the EIA-23 as the sampling frame. However, it was established that the frame is dynamic and EIA was concerned with potential challenges in obtaining responses from smaller companies. Given the aforementioned concerns, SMG and RPD proposed a cut-off sample initially designed to provide 90% coverage at the national level and a comparable percent coverage in the areas of the Federal Gulf of Mexico, Louisiana, New Mexico, Oklahoma, Texas, Wyoming and Other States. Initial work indicates that this is a much more viable approach and is feasible using a selection of operators no larger than 350 respondents to achieve the desired percent coverage. The advantage to this sample is that the EIA-23 data will be more accurate for the largest companies so the data available for estimation will be as precise and timely as possible. This creates a necessary and beneficial link between the two surveys. Because this process requires estimation of only 10% of the volume, it is expected to be at least as accurate as what was expected from estimation based on a probability proportional to size method, plus it greatly reduces the effects of non-response.

While the original plan was to select a 90% cut-off sample, in practice the percent coverage was reduced to 85% in some areas, with 90% for the US Total. Studies with historical data showed that this sample could still yield the target accuracy of 1% at the U.S. level and 2.5% by State or area.

EIA initially planned to use a ratio estimator based on regression theory. While this standard ratio estimator has been used as part of the test phase during 2005, an alternative method, designed to model changes in the dynamic frame is considered more reliable<sup>45</sup>.

For cut-off samples, optimality is conditional on the assumption that the model holds. Statisticians concerned by this methodology point to the possibility of model failure, and the lack of empirical knowledge (via the sample) of how the smaller units behave. However, a cut-off sample provides the minimum mean square estimate of the total. Of course, because there is no element of randomization, a cut-off sample is not a representative sample.

### **Part 4. Description of the Frame**

The EIA-914 cut-off sample<sup>6</sup> is selected from the sample of approximately 1,500 operators selected to respond to [Form EIA-23, "Annual Survey of Domestic Oil and Gas](#)

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<sup>4</sup> Estimation Study: [http://www.eia.doe.gov/smg/asa\\_meeting\\_2004/fall/files/914estimates.doc](http://www.eia.doe.gov/smg/asa_meeting_2004/fall/files/914estimates.doc)

<sup>5</sup> Adjusted Estimates of Texas Natural Gas Production:  
[http://www.eia.doe.gov/pub/oil\\_gas/natural\\_gas/feature\\_articles/2005/adjtxprod/adjtxprod.pdf](http://www.eia.doe.gov/pub/oil_gas/natural_gas/feature_articles/2005/adjtxprod/adjtxprod.pdf)

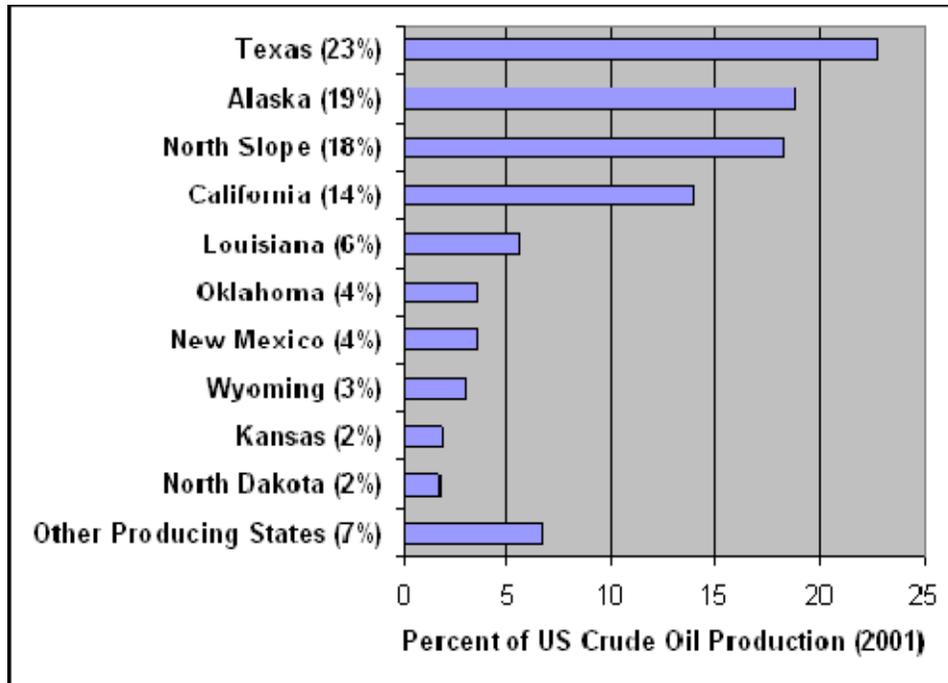
<sup>6</sup> Background and Methodology:  
[http://www.eia.doe.gov/oil\\_gas/natural\\_gas/data\\_publications/eia914/eia914meth.pdf](http://www.eia.doe.gov/oil_gas/natural_gas/data_publications/eia914/eia914meth.pdf)

[Reserves.](#)” The list of 1,500 operators contains the top producing gas companies in the United States. The EIA-23 sampling frame contains approximately 15,000 potential respondents, which are drawn from a master list of nearly 21,000 well operators maintained by EIA. Natural gas producers comprise a highly skewed and volatile industry, with a small number accounting for the majority of the natural gas production in the United States. There are approximately 280 respondents to the EIA-914. This number can change over time as companies merge, buy and sell properties, or go out of business. The initial cut-off sample was chosen to yield at least 85 percent coverage for each surveyed area and 90 percent coverage for the Lower 48 States.

## Part 5. Next Steps

EIA is considering an expansion of the EIA-914 to cover crude oil production in addition to natural gas production. This is efficient because many companies, especially large ones, produce both oil and natural gas. EIA would add a schedule for crude oil production which would be similar to the current form for natural gas production. The geographic areas for crude oil will be somewhat different from those for natural gas (Figure 2). EIA estimates that the cut-off sample of 250 companies will need to be expanded to a total of 350 companies in order to achieve the required coverage for both crude oil and natural gas production.

**Figure 2. Major Crude Oil Producing States (2001)**



The companion paper by John Wood will provide additional information about the

sample expansion needed to include crude oil production. It will also describe an enhancement to the estimation methodology applicable to both crude oil and natural gas production.