



Independent Statistics & Analysis

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Administration

Supporting Statement for Manufacturing Energy Consumption Survey

Part B: Collections of Information Employing Statistical Methods

Form EIA-846, Manufacturing Energy Consumption Survey

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Form EIA-846, *Manufacturing Energy Consumption Survey*, is a mandatory survey that collects data on energy consumption and expenditure data from establishments in the manufacturing sector; i.e., North American Industry Classification System (NAICS) codes 31-33. The information from this survey is used to publish aggregate statistics, at the National and Census Region levels, on the consumption of energy for fuel and nonfuel purposes, as well as certain energy-related issues such as energy prices, on-site electricity generation, purchases of electricity from utilities and non-utilities, and, occasionally, the capability to switch fuels. The MECS is also used to benchmark EIA's industry forecasting model and update changes in the energy intensity and greenhouse gases data series.

The 2018 MECS survey plan will largely follow the 2014 plan. The 2018 MECS will use the Census Bureau's 2017 Business Register to identify establishments eligible for MECS. The U.S. Census Bureau will conduct the fieldwork for the survey, acting as EIA's data collection agent. The target population for the 2018 MECS will be comparable to that of the previous MECS, a restricted universe of manufacturing establishments above minimum size thresholds by NAICS industry established for the 2012 Economic Census - Manufacturing (ECM).

An Internet-based electronic reporting method will be available for the 2018 MECS. The Census Bureau will mail a letter along with the questionnaire. For those establishments that have Internet access the letter will give detailed instructions on how to complete the questionnaire through the Internet. However, for those establishments without Internet access or who choose not to use the Internet data collection method, the mailed questionnaire may be completed and sent back to the Census Bureau. Nonresponse follow-up procedures, as described in Section 3 below, will be similar to those used in 2014, which are performed to maximize response rate. Data processing and editing will be aided by modernized, automated data entry and storage equipment and editing procedures. Economic data from the 2016 Annual Survey of Manufactures (ASM), where appropriate, will be added to the MECS data file, similar to previous MECS, to provide extra analytic capability with no added burden on respondents. For non-ASM cases, economic data will have to be imputed or ratio adjusted from the 2012 ECM.

B.1. Respondent Universe

The 2018 MECS sample will be approximately 15,000 establishments. The frame for the MECS will be based largely on the NAICS classifications of the 2017 Business Register and the annual payroll thresholds by industry established for the 2012 ECM mail-out, which cover approximately 170,000 manufacturing establishments and accounted for the top 97 to 98 percent of the total payroll in the manufacturing sector.

B.2. Statistical Methods

The 2018 MECS frame will be stratified by NAICS industry with some provisions to also stratify according to Census Region. Independent samples are selected by stratum. Industry-by-region data will continue to be published as in previous MECS. The major portion of the MECS sample will be devoted to the strata defined by the 3-digit NAICS subsectors that comprise manufacturing and 30 to 40 4-digit industry

groups and 6-digit industries, all at the Census Region level. The industry groups and sub-industries will be chosen based upon their fuel consumption, economic output, feedstock usage, other programmatic interest, and carbon dioxide intensity. Similar to the 2014 MECS sample, 23 industries are expected to be selected with certainty (i.e., all establishments listed for those industries are selected into the MECS sample). For other industries, maximum bounds on the sampling weights and target coefficients of variation (CVs) for estimating total measure of size are set depending on the NAICS level (six, four, or three digit) as well as other factors such as energy intensity.

The measure of size (MOS) is used to assign overall probabilities of MECS selection to each establishment, excluding the MECS certainty strata. The 2018 MECS MOS will be the sum of annual cost of fuel and cost of electricity (CF). These data come from the ASM, the ECM, or are imputed. The ASM is a sample survey of approximately 50,000 manufacturing establishments and measures many of the same economic variables that the ECM does, including cost of fuels. The 2018 MOS will be determined from the 2016 ASM, the 2012 ECM, or imputed values by multiplying 2016 payroll data on the Business Register by the median ratio of 3-digit NAICS 2012 ECM CF to 2012 payroll. Imputation is used when necessary for all establishments that have missing cost of fuels and electricity data.

The MECS uses a probability proportionate to size (PPS) approach to assigning inclusion probabilities to manufacturing establishments in the strata. However, the MOS is not highly correlated with measured values of energy consumed as a feedstock and certain energy sources used as a fuel. To address this, as in previous MECS, the 2018 MECS will select with certainty establishments in the frame known to be significant consumers in these areas.

After the inclusion probabilities are assigned, a modified version of a sample selection algorithm called Pareto sampling¹ is employed to obtain the 2018 MECS sample. Since the 1998 MECS, the sample in each stratum is of a fixed, predetermined size. This benefits the MECS by preventing cost overruns due to the actual sample size being larger than was expected. Additionally, this selection method has been used since the 2010 MECS, instead of Tillé sampling, because the variance is simple and easy to estimate and does not involve joint probabilities. Also, Pareto sampling is easy to implement and to transfer knowledge to maintain the sampling program if in the future certain modifications are desired.

The statistic reported for each stratum is an estimator of the total of some measure of energy consumption (e.g. the total natural gas, in billion cubic feet, for the Northeast primary metals industry). Modified Horvitz-Thompson estimators are used for estimating totals. For each stratum, the estimates are of the following form:

$$\hat{Y}_s = \sum_{i=1}^{n_s} w_i^{a_{\hat{q}_i}} \cdot (y_i)$$

where:

¹ Pareto sampling was introduced in two articles by Bengt Rosén [Journal of Statistical Planning and Inference 62 (1997) pp. 135-158 and pp. 159-191]. It is also referenced by Särndal and Lundström (Estimation in Surveys with Nonresponse, Wiley 2005 p. 31).

$y_i, i = 1 : ns$ are the values of the consumption measure for the ns establishments in stratum s that were selected for the sample and responded.

W_i^{adj} , $i = 1 : ns$ are the final weights for the ns establishments in stratum s that were selected for the sample and responded, where the final weight for an establishment is the sample weight, which is defined as the inverse of the establishment's probability of selection, multiplied by an adjustment factor that corrects for unit nonresponse and births and deaths in the population using data extracted from the 2018 Business Register.

$$\hat{Y}_s \text{ is an estimate for } Y_s = \sum_{i=1}^{N_s} y_i \text{ which is the actual total for stratum } s$$

Population totals will be estimated from 2018 MECS data by summing the weighted sample data based on the final weights. For the 2010 and 2014 MECS, the adjustment factors were calculated separately for certainty and non-certainty establishments within adjustment cells that were based on the strata. That practice will likely be continued for 2018.

The MECS provides estimates for the number of establishments consuming a particular type of fuel (e.g. coal) by NAICS code at the national level or for the number of establishments participating in an energy management program. To produce these estimates, the estimated establishment counts from the 2018 MECS sample are poststratified as follows. First, the 2018 MECS sampling frame is updated using the Census Bureau's 2018 Business Register. The NAICS code for establishment records on the sampling frame is updated using the 2018 Business Register, and records with an incomplete or out-of-scope NAICS code are removed from the updated sampling frame. The sampling frame may be augmented with records for births based on the 2018 ASM birth processing. For a given industry grouping, the estimated establishment count is then set equal to the corresponding establishment count from the sampling frame. During this calibration procedure, the final weight for each respondent is adjusted while ensuring that the adjusted final weight is not less than 1. An estimated establishment count is then calculated by summing the adjusted final weights after post stratification for the respondents having the characteristics of interest.

B.3. Maximizing Response Rates

To maximize response rates, EIA surveys and instructions are designed and written for clarity and conciseness. Data that are not expected to change from year-to-year are prepopulated on the forms. Notifications are mailed to maximize the time that respondents have to complete the survey.

The weighted coverage rate (ratio of the total weighted MOS of the responders to the total weighted MOS of all establishments in the sample) for the 2014 MECS was approximately 83 percent. By using the Census Bureau as the data-collection agent, the survey is not only under the data-collection authority of the DOE mandate, but also has the confidentiality protection that Title 13, Section 9, of the U.S. Code confers on surveys conducted by the Census Bureau.

The Census Bureau has developed standard procedures for nonresponse follow-up and calculation of response rates. The Census Bureau will conduct two mail follow-ups, as well as a telephone follow-up of the largest delinquents. Smaller delinquents will receive only the two mail follow-ups. An enhancement to the telephone nonresponse follow-up instituted for the 2002 MECS will be continued for the 2018 MECS. In that procedure, follow-up was done to maximize response of establishments that have the greatest MOS in the adjustment cells. The procedure established target coverage rates (ratio of the total MOS of the responders to the total MOS for all sampled establishments in a given stratum) for the follow-up based on the overall importance of the cell.

B.4. Test Procedures and Form Consultations

This will be the tenth time the MECS will be conducted. After consideration of past results and outside consultations (as described in Section A-3), the questionnaire has undergone substantial redesign in the method of collection. The effectiveness of these changes was analyzed during the editing and review of the 2010 MECS data. The respondents actively supported the changes during the post-survey interviews of respondents in 2012. The few changes to the instrument for 2014 targeted opportunities for increased data reporting frequency, improved data quality, and reporting efficiency. No changes to the questionnaire are anticipated for the 2018 MECS.

In carrying out the 2018 MECS, the Census Bureau will use fieldwork procedures similar to those routinely used for the ASM and that were used for the 2014 MECS. No further tests of procedures are planned.

B.5. Statistical Consultations

The U.S. Bureau of the Census is selecting the MECS sample under the supervision of Colt Viehdorfer, Chief of the Manufacturing Surveys Statistical Methods Branch. Mr. Viehdorfer can be reached at (301) 763-6796. The overall administrative responsibility for MECS at the Census Bureau rests with Kevin Deardorff, Division Chief of the Economic Reimbursable Surveys Division. Mr. Deardorff can be reached at (301) 763-6033. For questions or additional information regarding the statistical methods for this survey, contact Tom Lorenz, Survey Statistician, at (202) 586-3442, email Thomas.lorenz@eia.gov, of the Office of Energy Consumption and Efficiency Statistics within the Office of Energy Statistics of the U.S. Energy Information Administration.