EIA Data News

The Response Analysis Survey: Evaluating Manufacturing Energy Consumption Survey Methodology

by Robert K. Adler*

The Manufacturing Energy Consumption Survey (MECS) has been conducted triennially by the Energy Information Administration (EIA). It is a major data-gathering effort that involved more than 14 thousand manufacturing establishments in 1991, the year of the most recent published survey. Because MECS is the only comprehensive source of data on U.S. manufacturing energy use, EIA continually seeks ways to improve its accuracy and effectiveness. In 1985 and 1986, before the first MECS was launched, EIA conducted a pilot survey of 78 manufacturing establishments to pretest the MECS format, instructions, and questions. Since then, ongoing querying of participants has led to the reshaping of several sections of the survey.

With the 1991 MECS,[1] new groups of questions were added concerning manufacturers' allocation of fuel to specific end uses, the square footage of manufacturing establishments, and the use of energy-saving technologies. To evaluate the effectiveness of those new questions and participants' ease of response to them, EIA developed and conducted a Response Analysis Survey (RAS) of selected MECS respondents in late 1992. The RAS also provided an opportunity to solicit open-ended suggestions for improving the MECS in general.

This "EIA Data News" item discusses the sample of MECS respondents included in the RAS, the RAS's design and execution, the results of the survey, and the ways those results contributed to the design of the 1994 MECS.

RAS Sample Design and Survey Methodology

Unlike the MECS, which is required by law and thus can command high response rates, the RAS was entirely voluntary. In order to secure adequate, representative coverage of the MECS sample, a target of 200 RAS responses was selected. To offset likely refusals to participate, 400 establishments were selected from the 1991 MECS sample of 14,299 and approached to take part in the RAS. The final RAS sample numbered 199.

The 199 RAS establishments were selected not at random, but rather to reflect the proportions of the various major industry groups in the MECS sample. If the contact person at an establishment declined to take part in the RAS, another establishment from the same Standard Industrial Classification (SIC) and size group[2] was contacted. Of the 199 cases, 43 replaced first-round selections. This procedure ensured that SIC groups that were more heavily represented in the MECS sample, such as the food and kindred products industry and the chemicals and allied products industry, also enjoyed proportionally greater representation in the RAS sample.

The RAS establishments were contacted by telephone 2 months after receipt of the MECS questionnaires. Each interview proceeded immediately or at a later time more convenient for the respondent. Interviews normally lasted no more than 20 minutes.

Although the RAS posed a total of 29 questions, the actual number asked of a given respondent depended upon the relevance of certain questions or sets of questions. Questions were grouped as follows:

- Twelve questions, including two multipart questions, pertained to end-use consumption. For example, respondents were asked to name the major source of information they used in preparing their estimates of end-use consumption as a fraction of total consumption and to rate their confidence in the accuracy of those sources and the difficulty of estimating the end-use breakdown by energy source. They were also asked if they could have provided actual end-use consumption estimates.
- Ten questions pertained to establishments' total square footage and to square footage that was heated or cooled or both. Again, respondents were asked to identify the major sources of information used in arriving at their estimates. In the MECS, respondents were asked to give estimates in terms of ranges, and RAS respondents were

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[1]Energy Information Administration (EIA), *Manufacturing Consumption of Energy 1991*, DOE/EIA–0512 (91) (Washington, DC, December 1994).

[2]Size was defined as large or small, depending upon whether the establishment was above or below the median for its SIC group in terms of its energy measure of size, a composite index derived from Bureau of the Census data on each establishment's quantity of purchased electricity and the cost of purchased fuels other than electricity.

asked if they would have been able to classify their buildings by narrower ranges or to give individual square-footage estimates.

- Two questions asked respondents if they were easily able to identify the names and descriptions of specific energy-saving technologies used in their establishments (e.g., computer control of building environment, waste heat recovery, and adjustable speed motors) and if the MECS failed to mention any energy-conservation technologies in use at RAS establishments.

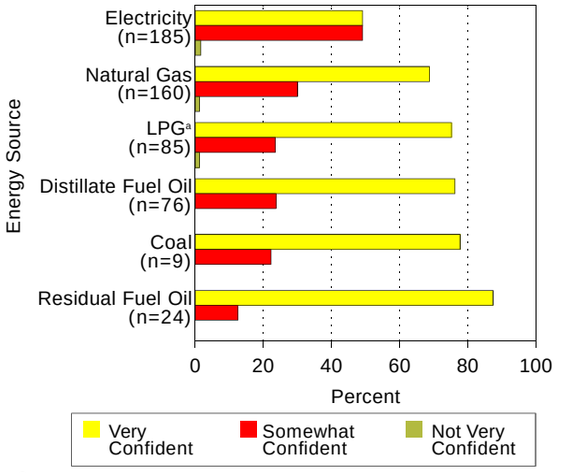
- The final group of five questions asked respondents for suggestions about additional information the MECS should gather and about ways to make the MECS easier to understand and respond to. One multipart question asked respondents about their ability to estimate their establishments' utilization of production capacity.

Results

End-use estimates. Ninety percent of RAS respondents completed the MECS section asking about energy end uses at their establishments. That group was asked to describe the major source of information they used in preparing their estimates. Thirty-three percent said that they used "previously recorded end-use data" or "previously developed formal engineering estimates." Another 43 percent said they used "well-considered but informal estimates." Eleven percent said they used "very rough estimates" and 13 percent said they used other means.

RAS respondents were also asked to state the level of confidence they felt in their end-use estimates of each energy source actually used at their establishments; the three choices were "very confident," "somewhat confident," and "not very confident." Less than 2 percent of responses fell into the "not very confident" category. Confidence in estimates of combustible fuel consumption was generally high (Figure 1).

Figure 1. Confidence in End-Use Allocation Estimates by Energy Source



[a]LPG=Liquefied petroleum gases.

Note: n is the number of RAS respondents that used each energy source and answered the question series for that energy source.

Source: EIA, Office of Energy Markets and End Use (EMEU), *The Response Analysis Survey for the 1991 Manufacturing Energy Consumption Survey*, unpublished draft report, dated June 29, 1993.

Similarly, respondents were asked to describe their difficulty in completing the end-use estimates for each energy source. In this case, there were four choices: "very difficult," "difficult," "easy," and "very easy." For combustible fuels, as many as one-quarter of respondents characterized the estimates as difficult or very difficult to compile. For electricity, the fraction was nearly one-half. The difficulty of estimating end-use allocations for electricity and natural gas increased significantly with the number of end uses at an establishment (Figures 2 and 3). The other fuels were, in general, used in fewer ways and respondents reported less difficulty in estimating allocations.

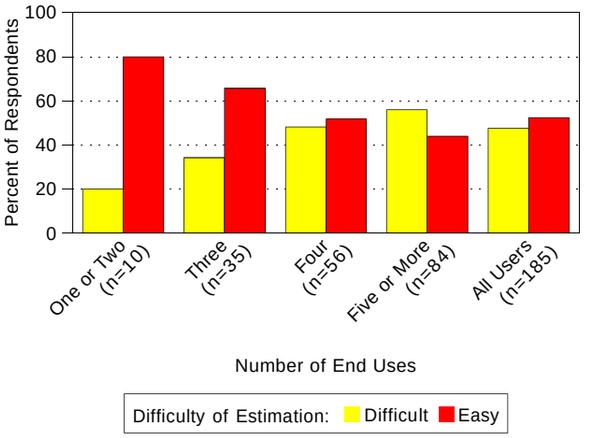
Square-footage estimates. The MECS asked respondents to provide an estimate of the enclosed area of their manufacturing establishments by selecting a square-footage category. Among the participants in the RAS sample, 96 percent gave such an estimate, and 80 percent of those were also able to give precise numbers taken from records, blueprints, or measurements. Another 14 percent gave "well-considered but informal estimates." Two percent gave "very rough estimates" and 4 percent used other estimation methods. Of the 20 percent of respondents who did not provide a precise square-footage number, about one-quarter said they would be willing to do so in future surveys. Thus, about 15 percent of those respondents who gave square-footage estimates preferred to continue reporting square footage in terms of categories.

The MECS also asked for data on controlled areas (those areas that are heated or cooled or both), and 93 percent of the RAS respondents gave such an estimate. In contrast to the earlier question about total enclosed square footage, however, only 47 percent of RAS respondents who selected a controlled-area category could also have supplied a precise square-footage number.

Technologies. MECS respondents were asked to select from a list of options to categorize the technologies used within their manufacturing establishments. Most of the RAS sample said they were easily able to identify the technologies. Ten percent reported some difficulty in understanding one or more of the technology descriptions. RAS respondents were also asked to suggest additional "state-of-the-art" energy conservation technologies for inclusion on future MECS; 11 percent made such suggestions.

Other questions. The fourth section of the RAS asked respondents for suggestions on additional information that should be collected by the MECS and on ways to make the MECS easier to understand and complete. Among the suggestions for additional information were pollution control technologies already in place and expenditures on energy conservation activities. A few respondents suggested that the form or the instructions be simplified and that a customized form for smaller establishments be developed. When asked about survey formats, more than three-quarters preferred the current paper questionnaire exchanged by mail, while 15 percent preferred facsimile transmission and 6 percent preferred submitting a computer diskette.

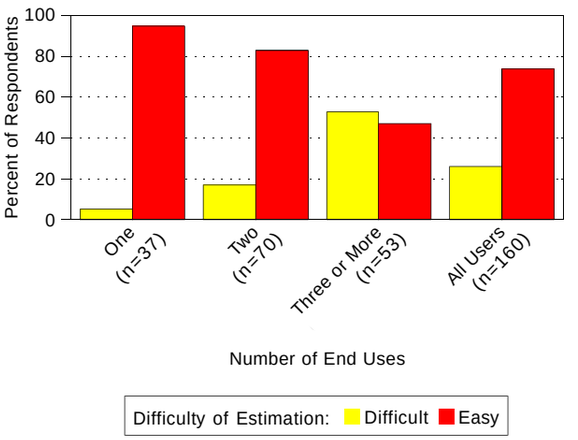
Figure 2. Difficulty of Electricity End-Use Estimation By Number of End Uses



Note: n is the number of RAS establishments with the designated number of electricity end uses.

Source: EIA, EMEU, *The Response Analysis Survey for the 1991 Manufacturing Energy Consumption Survey*, unpublished draft report, dated June 29, 1993.

Figure 3. Difficulty of Natural Gas End-Use Estimation By Number of End Uses



Note: n is the number of RAS establishments with the designated number of natural gas end uses.

Source: EIA, EMEU, *The Response Analysis Survey for the 1991 Manufacturing Energy Consumption Survey*, unpublished draft report, dated June 29, 1993.

Survey Limitations and Conclusions

Although the RAS sample was drawn to represent the much larger MECS sample with the greatest accuracy and fewest biases possible, not every aspect of the survey could be controlled. For example, several questions required subjective responses, such as those asking respondents to judge the difficulty of making estimates and their confidence in the results. A given level of effort might be labeled “easy” by one respondent and “difficult” by another. Further, the assignment of responsibility for responding to the RAS was completely left to the manufacturing establishments and was not controlled or influenced by EIA in any way. Inevitably, that responsibility fell to a range of specialists, from clerks and accountants to engineers and energy managers. Although in general the respondents were knowledgeable about the MECS, it is likely that their respective areas and levels of expertise varied.

The major purpose of the RAS was to probe the current MECS methodology. The results of the RAS confirmed that the MECS, including its new sections, was well managed by respondents. Respondents were mostly successful in apportioning consumption of major fuels to the end uses listed in the MECS. It also appeared that adequate data were available to respondents to justify asking for precise square-footage estimates, although categories (perhaps more narrowly defined than at present) might be retained for the controlled square-footage estimates. Understanding of the technologies section was generally good, although more explicit definitions could be beneficial. Comments concerning the technologies and their definitions were considered as the MECS was revised for 1995.

Although the MECS is fundamentally sound, the RAS results prompted a few changes in the 1994 MECS questionnaire, which is expected to be sent out by mid-1995. The most important change will be to ask for a precise number for enclosed square footage, rather than allowing respondents to select a category. Respondents with questions will be able to contact survey personnel by means of a toll-free telephone number, and those personnel will have more specific information available to clarify definitions and instructions. In addition, respondents may be offered the option of submitting completed questionnaires by means of facsimile transmission and possibly by computer diskette.

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