EVALUATING THE PERFORMANCE OF ENERGY CONSERVATION PRODUCTS WHAT ARE THE ISSUES?

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Bonneville Power Administration (BPA) has studied the performance of a variety of energy conservation products including: water heaters, solar water heating systems, refrigerators, electric motors, heat pump water heaters, and windows. The authors have observed that a number of important issues are common across the whole spectrum of products.

There are typically three related but distinct sources of performance information: predictive techniques, and monitoring data and ratings. Figure 1 shows how these sources of information are typically related. Table 1 provides specific details for three example types of products.

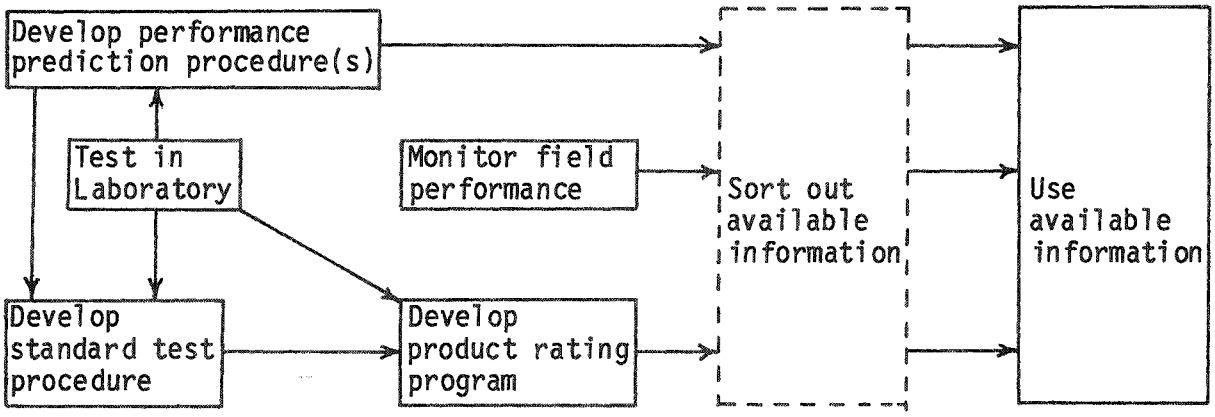

Figure 1. Typical process for evaluating conservation product performance.

Table I. Performance evaluation for specific products.

Product	Performance Prediction	Standard Test	Type of Rating
Solar Water Heating Systems	TRNSYS & f Chart	ASHRAE 95-81 & OR Dept of Energy	Single Point
Refrigerators	None identified	US DOE, Fed Register V 47(154) 34517-34529,1982	Single Point
Electric Motors	EPRI Computer program analyzing use of variable speed drive	ANSI/IEEE std 112-1984	Multi-condition

Performance prediction techniques are the most reliable means of estimating performance under situations for which there is no direct data. Early in the product development phase, these situations abound (there will always be some). Though predicitive techniques give an exact answer, this answer is not necessarily accurate, because the input parameters are often simply estimates. Due to the inherent complexity of this approach, the use of predictive techniques (validated or not) is usually limited to situations where engineering skills and engineering data are available, such as large building designs.

Long-term utility planning generally involves monitoring. However, even monitored performance is usually not an accurate indication of the actual performance of non-monitored systems. There are at least three reasons for this descrepency: (1) Monitoring typically lags technology development (i.e., new installations) by two years. Thus low-performance problems identified may already have been corrected by the industry by the time an analysis is available. (2) Controls placed on the monitoring projects often are different than those in place for large field applications. Monitoring is also used to identify problems with the technology and delivery procedures which would be addressed in large scale programs. (3) Relatively few monitoring projects have statistical validity due to the number of variables involved and the high cost of monitoring.

Despite disclaimers to the contrary, we believe purchasers and other users assume that ratings directly correlate with long term field performance. Such an assumption is generally not accurate because of uncontrolled variables which include: (1) Homeowner action, including use, abuse, and maintenance, (2) installation variations, (3) micro climates, and (4) production line product variability. Uncontrolled variables will often have effects of the same order of magnitude as the desired or predicted energy savings. A single condition rating may not provide sufficient information to accurately project energy consumption for situations diverse from the test conditions. BPA's research has indicated that this is the case for heat pump water heaters.

While each of the sources of performance information addressed above may have a common root, relatively little emphasis is placed on coordinating their use for a particular purpose. Consumers rarely see monitored performance information which might be considered more reliable than ratings. Utilities have difficulty using the compiled rating information for planning even though it is the most current information available.

Several questions are posed below in order to bring these issues into focus.

Would it be useful to formalize a relationship between prediction, monitoring, and rating activities?

> Yes. Validating or qualifying prediction techniques is perhaps the best use of monitored data. Having reliable performance information is critical for utilities if the cost of purchased energy conservation is to be compared with the cost of new generation capacity. BPA has just finished a research project to correlate ratings and predictive procedures for solar systems.

Is it necessary to reconcile the fact that field performance will not be the same as rated, monitored, or predicted performance?

Yes. Too optimistic a projection of performance leads to poor economic investments. Too pessimistic a projection results in premature disillusionment with a product. One approach to dealing with the problem is to establish a range of expected energy performance instead of a single number. The EPA mileage ratings for cars accomplishes this by providing both a "highway" and a "combined" rating. Electric motors are rated at various loads and this information is provided in the form of performance curves. If nothing else, providing a multicondition rating discourages use of a single number as gospel. Taking this principal one step further, the 90% confidence levels observed in monitored data should be given more credence than the average performance.

Can the standards development process be better managed to produce ratings more indicative of actual field performance?

Probably not. Developing rating parameters which will serve as inputs into existing (or future) performance prediction techniques is a worthwhile goal, but standards making is a consensus process participated in by individuals or groups, often with very narrow interests.

Is it useful to develop data banks containing the latest monitored data?

Selective data banking would be very helpful to coordinate the performance analysis techniques as recommended above. However, Utilities and States typically need monitored sites in their region to develop confidence in a particular product. Also, data-banked information tends to be several years old and therefore of questionable validity by the time it can be used for specific applications.