Monitoring and Evaluation

1. Introduction

This report describes MidAmerican's proposed monitoring and evaluation activities (M&E) for the plan period.

2. Objectives of Monitoring and Evaluation Activities

MidAmerican's energy-efficiency monitoring and evaluation (M&E) activities have one primary objective: optimal program performance. Well-designed monitoring, verification and tracking functions provide comprehensive and timely data to program managers. Timely data allows them to monitor program performance and identify and correct problems related to achievement of program goals on a continuous basis. Process research and monitoring provides continuous and timely feedback that provides management the information needed to correct problems as they arise.

3. Evaluation Strategy

At the highest level, MidAmerican's proposed evaluation plans and strategy are as follows.

- Process evaluations will be completed as needed as program designs, orientation and delivery change and as new programs are introduced. This will provide feedback on how well each program is performing relative to stated goals.
- Impact evaluation activities will provide information on how much actual savings vary from estimated savings. Impact evaluations will rely on a mix of engineering algorithms, simulation modeling and metering to estimate actual savings. The choice of methodology

will be determined by the size, cost and complexity of the measures installed, as well as the program delivery strategy employed.

- Verification activities will ensure that measures are installed consistent with program requirements and, where appropriate, also will provide information to help improve impact estimates. For some programs, incentive payments are tied to verified savings.

MidAmerican's evaluation approach is designed to be efficient. A key element of MidAmerican's approach is that the evaluation effort is generally structured by evaluation function, rather than by program or customer sector. Each major function, such as process or impact evaluation, starts from an area-wide perspective, with approaches and issues that span all or most program areas. Broad cross-sector evaluation activities then will be focused as needed for each program and provide conclusions specific to that program.

This approach will allow substantial efficiencies in developing and interpreting the information that is gathered for each program. Not only are there many commonalities in program structure and delivery method across the various energy-efficiency programs, but also many of the required evaluation functions are similar even where program delivery methods may vary. In addition, as noted, this approach will allow evaluators to look for consistencies across programs, rather than viewing each program independently.

4. Process Evaluation

Overview of Process Evaluation Approach

Process evaluation is the review and assessment of the program administrative structure, processes and implementation. The goal of process analysis is to develop recommendations for improving the management and functioning of the programs so they can more effectively achieve their goals. Process analysis addresses the design and functioning of the program's administration and not (or at least not directly) the choice or design of the program activities.

MidAmerican completed a residential process evaluation in 2005 and a nonresidential process evaluation in 2006. Many of the recommendations have been implemented and some are still under review.

5. Impact Analysis and Monitoring and Verification

Overview of Impact Analysis Approach

MidAmerican will employ a combination of strategies to estimate measure and program-level impacts. Impacts from:

- The ***Residential Equipment***, ***Residential Audit***, ***Residential Low Income***, ***Nonresidential Equipment*** and ***Nonresidential Audit*** programs will be estimated based on engineering estimates, adjusted for known customer-specific factors such as equipment size and efficiency. Engineering reviews will be done periodically to determine the accuracy of the engineering estimates and adjustments may be made, where warranted.
- Both the ***Residential and Nonresidential Load Management*** programs will be estimated based on detailed load metering. The impact evaluation for the residential load management program will be completed during 2007. The impact evaluation strategy for the nonresidential load management program is to use interval meter data from all participants to measure demand savings on curtailment days. Load levels on curtailment days will be compared to similar peak noncurtailment days to calculate program impacts and customer compliance at the end of each season.
- The ***Residential New Construction*** program will be based initially on modeled savings for a typical home and sometimes on individually-modeled homes. As necessary,

engineering reviews will be updated, based on actual new home characteristics and savings estimates may be adjusted accordingly.

- The ***Commercial New Construction*** program will be based on detailed site-specific ex-post verification and building simulation modeling for each participant.
- The ***Nonresidential Custom*** program will be established based upon initial engineering estimates made in order to pre-qualify rebates prior to implementation. As necessary, ex-ante and ex-post metering also will be employed to improve the accuracy of the engineering estimates.

Overview of Verification Approach

MidAmerican will undertake extensive activities to verify that measures have been installed according to program guidelines. For most programs, MidAmerican's program contractors perform verification inspections for a sample of participants. For the Residential and Commercial New Construction programs, a majority of buildings are inspected by MidAmerican or certified by independent third parties to ensure that all required measures are installed properly. For Commercial New Construction, the company goes a step further and does building simulation modeling to calculate project savings based on its findings from the verification site visit, and participants then are paid incentives based on verified savings. The verification strategy for the Nonresidential Load Management program is to use the Curtailment Manager software to monitor program compliance in near-real time on curtailment days.

Engineering Review Process

As discussed previously, periodic engineering reviews of energy-savings algorithms will be done to verify the accuracy of initial savings estimates for standard measures. Where significant differences are found to exist, the savings assumptions may be adjusted. The following paragraphs describe the general approach likely to be taken for these engineering reviews.

For most projects and measures, the engineering reviews will be based largely upon examination and analysis of information provided on rebate forms, program tracking data, project documentation and measurement and verification data showing how energy savings were estimated. These reviews will reveal the degree of differences between actual savings and savings assumed in the program tracking database.

The extent of available data sources will define the scope of further efforts to collect and analyze data to estimate savings impacts for individual projects and/or measures. For most measures, it is likely that extensive data will be available from program operations and no further data collection will be needed. When program data is sketchy or incomplete, additional effort may be required to gather more comprehensive data, particularly for large custom projects.

For a sample of implemented projects, the evaluation will conduct project-specific analyses to estimate impacts. These analyses may include additional measure-specific data collection depending on the adequacy of program data and project documentation. Different levels of analysis may need to be conducted depending upon the complexity of the project or measure and its relative contribution to total program savings.

The first step in the engineering review will be to gather program data, including information provided on rebate forms, tracking data, project documentation and any program monitoring and verification data available. This data will be used to determine the types of measures involved, the degree of complexity in the algorithms used to calculate savings impacts and ultimately, the nature of the review process and analytical methods needed during the engineering review.

The review process for standard measures (generally those in the prescriptive programs) is straightforward. A standard measure requires a relatively simple algorithm that relies generally upon a change in otherwise constant-value parameters. An example is a lighting measure that simply reduces wattage parameters and/or hours of operation from one fixed schedule to another.

A nonstandard measure usually requires a more elaborate algorithm or perhaps many algorithms integrated in a model of operation. An example of a nonstandard measure would be a variable-frequency drive on a motor, the savings depending on variations in equipment loading. Most industrial process measures are nonstandard because of their loading variability and complexity.

For standard measures, a sample will be drawn and brief reviews conducted of the available program data and project documentation to check the completeness of information for developing savings estimates. The accuracy of those estimates then will be checked using standard algorithms.

Our approach to nonstandard measures and projects is correspondingly more complex. First, there is a compilation of project documentation. Many of the nonstandard measures and projects will come through MidAmerican's programs in which energy analysis assistance is provided. Therefore, comprehensive documentation of energy-savings calculations should be available. Technologies and projects associated with programs that do not provide in-depth energy analysis should nonetheless have extensive documentation as well, since the customer (or their consultant) will have done the analysis before turning it over to MidAmerican.

The second step is to review available documentation for completeness. In most cases, the required documentation should have been provided; however, callbacks to customers may be required on occasion to fill in any missing fields or clarify data provided.

Analytical Methods

Savings impacts will be estimated using three main types of analytical methods: engineering analysis, simulation modeling and metering. The particular method chosen will depend on the complexity of the project or measure and the availability of project documentation to perform the analysis.

These methods do not apply to all measures. Nor does increasing complexity of the method necessarily offer a more accurate result. Certain measures, however, do require specific methods to yield a reliable result.

Engineering analysis is the preferred method for standard measures such as lighting retrofits where the impacts are a function simply of wattage and runtime differences. It also applies to such retrofits as insulation and increases in efficiency of constant-load equipment.

Engineering analysis may require both standard project information plus on-site data collection by spot measurements of such values as power, combustion efficiency or flow rate that can verify that correct values are being used in engineering equations. For most of the more complex projects that we expect to be developed, the spot measurement data should have already been collected by the program contractor and be included with the project documentation. Therefore, little additional data collection effort should be required.

Simulation modeling is the preferred method for more complex measures, multiple measures and large loads that vary according to identifiable conditions or a known schedule. This method includes both operational simulation modeling and whole-building simulation. Operational simulation modeling is typically used to estimate energy-savings impacts from complex industrial process technologies, while whole-building simulation is required for very large new commercial buildings or commercial building retrofit projects. It involves elaborate engineering and computer analysis and usually requires substantial data on the systems or buildings affected by the implemented measure(s). Again, as above, any on-site spot measurements required should already be included with the project documentation.

Project documentation for several of the proposed programs should already include simulation modeling inputs and outputs. For example, the Commercial New Construction program performs post whole-building simulation modeling as part of its verification activities, thus no additional modeling is needed. For some of the industrial programs, extensive modeling will have been done when a project is initially analyzed. Program contractors also may do additional modeling at the verification stage. Thus, the focus of evaluation activities will largely be on reviewing a sample of these analyses, rather than performing the simulations themselves.

Table 1 lists the 10 programs and the various savings-analysis methods applicable to each. As noted above, the assignment of a method to a particular program does not necessarily mean that the evaluator will be performing that analytical step; more likely, their role will be reviewing the work done by others.

Table 1
Savings-Analysis Methods by Program Component

	Analysis		Simulation	
Program	**Engineering**	**Metering**	**Operational**	**Whole-Building**
Residential Equipment	✓			
Residential Audit	✓			
Residential Load Management	✓	✓		
Residential New Construction	✓			✓
Low Income	✓			
Nonresidential Equipment	✓			
Small Commercial Energy Audit	✓			
Nonresidential Load Management	✓	✓		
Commercial New Construction	✓	✓	✓	✓
Nonresidential Custom	✓	✓	✓	

Metered Data is the preferred method for load management programs.

During 2007, a detailed impact evaluation of the Residential Load Management program in Iowa will be completed. To assess program impacts, the evaluation relies on field inspections and installation of end-use metering on a large sample of participants. Because of the complexity of this task and the need to collect data during summer months when cycling is occurring, it has taken two years to complete.

Field inspections will be used to determine the degree to which air conditioner load is effectively being controlled. A sample of participants has been selected for these field inspections. Possible inspection results might reveal:

- Faulty switches that are unable to receive the signal to cycle,
- Switches that have been tampered with so the signal is not received and
- Air conditioners that are no longer being operated.

End-use metering has been installed on the air conditioner compressors of a sample of participants. The sample represents a subset of those sites with properly functioning equipment based on the field inspection findings. Load impacts will be calculated by comparing end-use loads on cycling days versus loads on comparable weather days in which there was no cycling. Impacts will be calculated using one of the following approaches: (1) load impacts will be calculated based on differences between loads on cycling versus non-cycling days; or (2) load impacts will be calculated based on differences in air conditioner loads for participants versus a control group. The end-use metering will provide load shapes as well as load impacts, which can help to answer questions concerning the impact of the program on shoulder periods during cycling days.

Metering also is used each year to calculate impacts from the Nonresidential Load Management program. Each program participant has interval meters installed and MidAmerican calculates program impacts by comparing metered load on curtailment days to load on non-curtailment days with similar characteristics.

Metering also is used, as appropriate, to improve the engineering algorithms and simulation modeling used to calculate impacts in the Nonresidential New Construction and Nonresidential Custom programs. Typically, metering is used to confirm operating characteristics for key equipment (e.g., lighting operating hours, cooling system temperatures).

6. Conclusion

MidAmerican is planning to implement a comprehensive set of monitoring and evaluation activities for its South Dakota energy-efficiency programs. These activities will provide program managers with timely information and feedback that will allow them to monitor program performance and identify implementation problems as they arise, helping the company achieve its overall energy-efficiency goals and objectives.

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