Navy Family Housing Energy Audit and Analysis Software

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ABSTRACT

This paper is a review of the development of a software application that analyzes energy consumption and conservation options for existing Navy Family Housing neighborhoods. This software was developed in response to Executive Order 12902, which requires energy audits of federally owned facilities, identification of energy conservation measures with a payback of ten years or less, and implementation of those conservation measures by the year 2005. This Windows 95 compatible application performs these audits by calculating energy loads and associated utility costs for entire homogeneous housing neighborhoods. An extensive facility database, containing building characteristics and weather and utility rate information, provides the basis for these calculations. This database is updated annually, incorporating changes in energy costs, additions and deletions to inventory, and revitalization of existing neighborhoods.

Energy conservation measures are calculated on an interactive basis. Both simple payback and savings-to-investment ratios are used to evaluate potential savings. Saving calculations incorporate both utility savings and maintenance avoidance and/or cost.

The application includes a Revitalization Wizard to adjust conservation measure costs when similar work is being performed for nonenergy reasons. For example, if windows are being replaced for nonenergy reasons, energy savings are automatically calculated for a vinyl, dual-pane low-E window at no cost. The rationale being that you only pay for the replacement window once, but you receive multiple benefits (i.e., energy, maintenance, lead-based paint removal, etc.). Similarly, savings on upgraded windows are calculated on the delta between their cost and the "base" window's cost.

Summary reports compare existing units' energy performances against a revitalized neighborhood with composite conservation measures and against new construction standards.

INTRODUCTION

The energy crisis experienced in the 1980s propelled the U.S. government to set goals for conserving energy in federal buildings, including military family housing. Executive Order 12902 established a goal of 30% reduction in energy consumption by the year 2005, from the baseline year of 1985. It requires that facilities be audited to identify energy conservation opportunities (ECOs) and that ECOs having a payback of ten years or less be implemented to achieve this reduction goal. Navy Family Housing represents approximately 70,000 housing units at 77 U.S. and 22 foreign locations. The 30% reduction goal equates to an estimated taxpayer savings of $30 million per year in today's dollars.

Typically, Navy Family Housing management staffs at the activity level do not include engineers nor would they have the technical expertise to design energy conservation projects. Yet they are the experts regarding the facilities' current condition and utility costs. Therefore, a Windows 95 compatible computer software application, the Energy Auditor, was developed as a project planning tool. It encompasses state-of-the-art engineering principles, yet it does not require a building energy consultant to perform energy assessments or to develop a preliminary strategy for improving energy efficiency. The Energy Auditor is not intended to replace the detailed engineering analysis that is performed during the project design phase.

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HOW IT WORKS

First, the Energy Auditor calculates energy loads and associated utility costs for entire homogeneous housing groups, i.e., neighborhoods. An extensive facilities database, containing building characteristics, weather and site factors, and utility rate information, models the existing load and consumption as a baseline. This database is updated annually, incorporating changes in energy costs and composition of the housing group characteristics.

Next is the task of choosing those measures that will best reduce energy consumption without being cost prohibitive to implement and maintain. This is an interactive process. The first step analyzes a number of ECOs that are appropriate to the existing condition of the building and site. For example, if the building already has water flow restrictors and a recently installed high-efficiency heating system, related ECOs are not included as possible improvements.

Calculations consider both implementation and maintenance costs, and ECO alternatives are grouped by category, such as "thermal shell" or "mechanical."

The first analysis models the potential effect on energy load, consumption, costs, and savings of each ECO as if it were implemented individually. In addition to bottom-line costs and savings, the planner can compare the effect of each ECO to various load requirements of the baseline, such as thermal or electrical. This pinpoints where the greatest cost savings can be realized and which ECOs make the most effective improvements: for example, adding insulation vs. upgrading systems. This analysis preselects the most cost effective ECO in each category based upon the calculated "simple payback" and "savings to investment" ratio, but the planner may select any combination of ECOs desired.

A second analysis is then run based upon implementing a combination of selected ECOs. This takes into account the synergistic effects of all improvements. For example, changing the light source from incandescent to fluorescent not only reduces the electricity requirements for lighting but also impacts the costs associated with heating and cooling. The planner interactively runs these "what if" scenarios, changing the combination of ECOs as necessary, until the 30% baseline reduction is targeted. A summary report identifies the 1985 baseline, the ECOs included in the plan, the costs/consumption/load of the current energy baseline as compared with the target plan, the percent reduction achieved, and the composite payback in years.

Further, to encourage the perpetual integration of energy savings into the Navy's programs for periodic maintenance and revitalization, a Revitalization Wizard was added to the Energy Auditor. This option identifies the scope of a revitalization project that is already being planned, then reduces the implementation costs of associated ECOs by the cost of the base improvement. The delta is the realistic cost of energy specific improvements. For example, if windows are being replaced for nonenergy reasons, energy savings are calculated for a vinyl, dual pane low-E window at no cost. Similarly, savings on upgraded windows, such as triple pane or heat mirror/krypton, are calculated using the difference between the base and upgrade cost. This illustrates whether or not the added payback is reasonable in light of all planned improvements.

Utility savings revealed via the Energy Auditor can help "sell" a project in the budget, i.e., justify the expense of the revitalization project as a whole. For example, since you pay for the installation of a replacement window once, it makes sense to maximize the benefits, such as maintenance or lead-based paint removal, not only in terms of other costs, but also regarding energy consumption This aspect appeals to housing managers whose goal is not only to be good stewards of energy resources but also to ensure that quality of life standards for the residents are sustained.

Plans for future enhancements include integration with additional Navy Family Housing programs, such as management and mitigation of environmental hazards.