# 6959

# Interaction of Heating and Cooling Energy Conservation Envelope Measures with Mechanical System Retrofits

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## ABSTRACT

*The Weatherization Assistance Program (WAP) National Energy AudiT (NEAT) has been specifically designed to provide Department of Energy (DOE) low-income weatherization managers with a tool permitting selection of energy conservation measures based on sound economic criteria.*

*Changes in the WAP policy and advances in auditing techniques led to the need to upgrade the current DOE-supported measure-selection technique used by agencies in their low-income weatherization programs. The addition of heating and cooling mechanical system retrofits and an increased emphasis on cooling-climate measures required a measure-selection technique capable of judging the cost-effectiveness of these new measures. The increased use of blower doors and furnace efficiency measures provided impetus to accommodate these advances into the program if participants desired their implementation. Pilot projects and field trials of audits utilizing these techniques, which specify the cost-effectiveness of measures unique to the homes being audited, have demonstrated two to three times the savings per dollars spent over other programs.*

*The program meets all current requirements established by DOE as an alternative audit, permitting program subgrantees to waiver the 40% material expense requirement. Envelope and machanical system measures interact, producing more realistic savings estimates than individual savings approximations. Use of a variable-base degree-day technique allows both heating and cooling envelope measures to be viewed as an integral system of retrofits rather than individual measures. Both heating and cooling energy consumption effects of measures are computed. Measure savings are discounted over the life of the materials.*

*The program can be run on a computer with a minimum of 400 kBytes of available RAM and at least one floppy disk drive. Distribution is via a single floppy disk accompanied by a second diskette with alternate weather data. Execution times for most building descriptions requires less than 30 seconds on an 8088 based machine.*

*NEAT was designed to operate within an existing audit program. It does not direct infiltration retrofit work, though it will accept cost and CFM data that allow it to estimate cost-effectiveness. Most "low-cost/no-cost" or occupant-dependent measures are not evaluated because they can often be implemented in the time necessary to gather and input the data needed for their evaluation or because their energy savings cannot be accurately predicted. Decisions regarding these measures should be determined outside the program, following auditors' observations. Total repair and administrative costs are accepted and can be used to compute the cost-effectiveness of the entire job, but such costs are not itemized.*

*Building description data are entered on screens, each screen containing complete information on all components of the same type (e.g., walls, windows, etc.). Screens are paged through in either direction, like the pages of a book. Default values are available and warnings indicate when entries are outside normal ranges. Setup routines allow the user to tailor the audit to his or her locale by inputting material and fuel cost data, selecting measures to consider, and loading the weather to be used.*

*NEAT's energy estimation technique (monthly variable-base degree-hour) utilizes algorithms from the Computerized Instrumented Residential Audit (CIRA) published in 1982. Individual measure savings are determined from published results or field tests. The program allows input of gas and electricity billing data against which predicted consumption may be compared. If the user desires, measure savings can be adjusted to reflect the billing data values.*

*Program output includes a ranked list of recommended measures, their estimated heating and cooling energy and dollar savings, implementation costs, as well as total project savings, cost, and savings-to-investment ratio. A material list specifies the quantities of major materials required to install the recommended measures. User comments are gathered and printed.*


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*Measures are added to the base building in order of their computed individual savings-to-investment ratios. Each succeeding measure is added, assuming that all measures of higher SIR are already installed. The effects of the resulting measure interaction can be demonstrated through many examples, from the effect of installing an evaporative cooler on the cost-effectiveness of other cooling measures to the increase in heating energy required when shading measures are implemented.*

*The presentation will include a brief demonstation of the program as it is used to predict the effect of interacting heating and cooling envelope and equipment measures.*